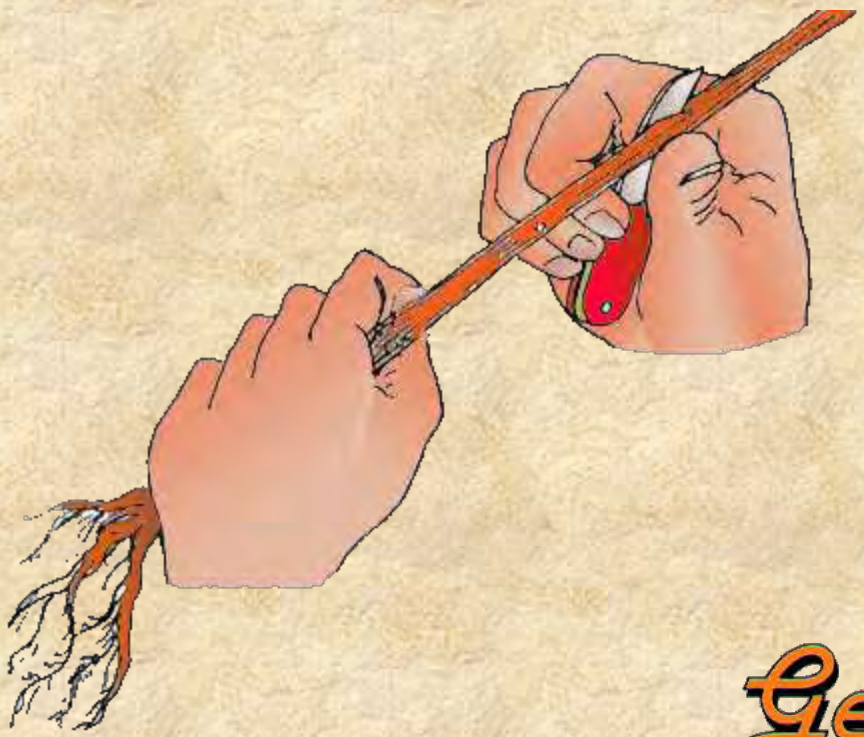
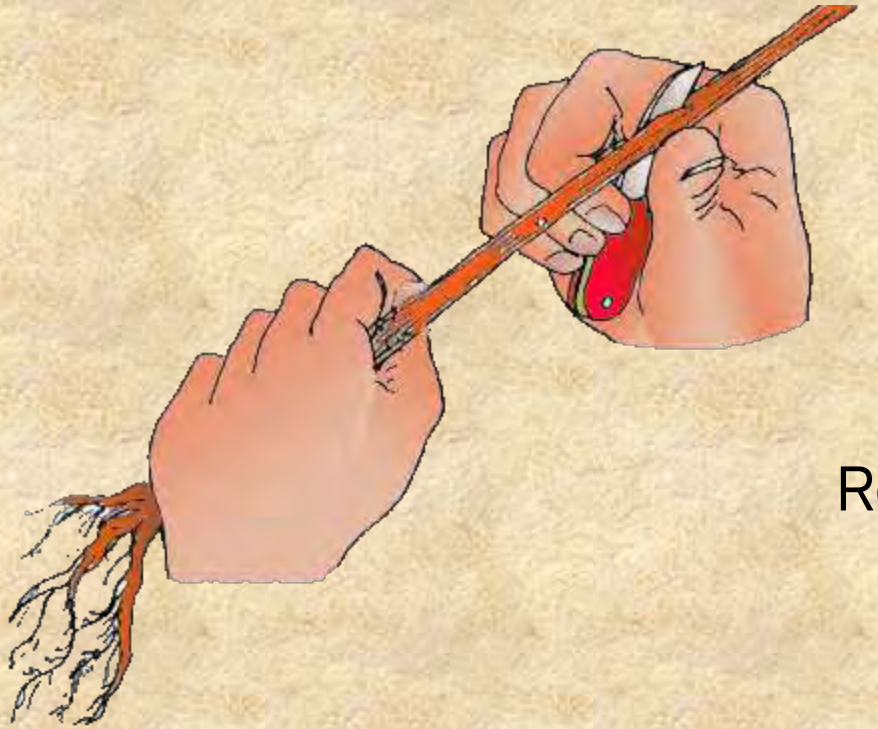
Grafting Fruit Trees



By George Tiger

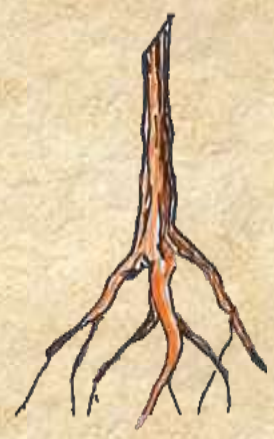
3/12-13/2013

Grafting



Scion

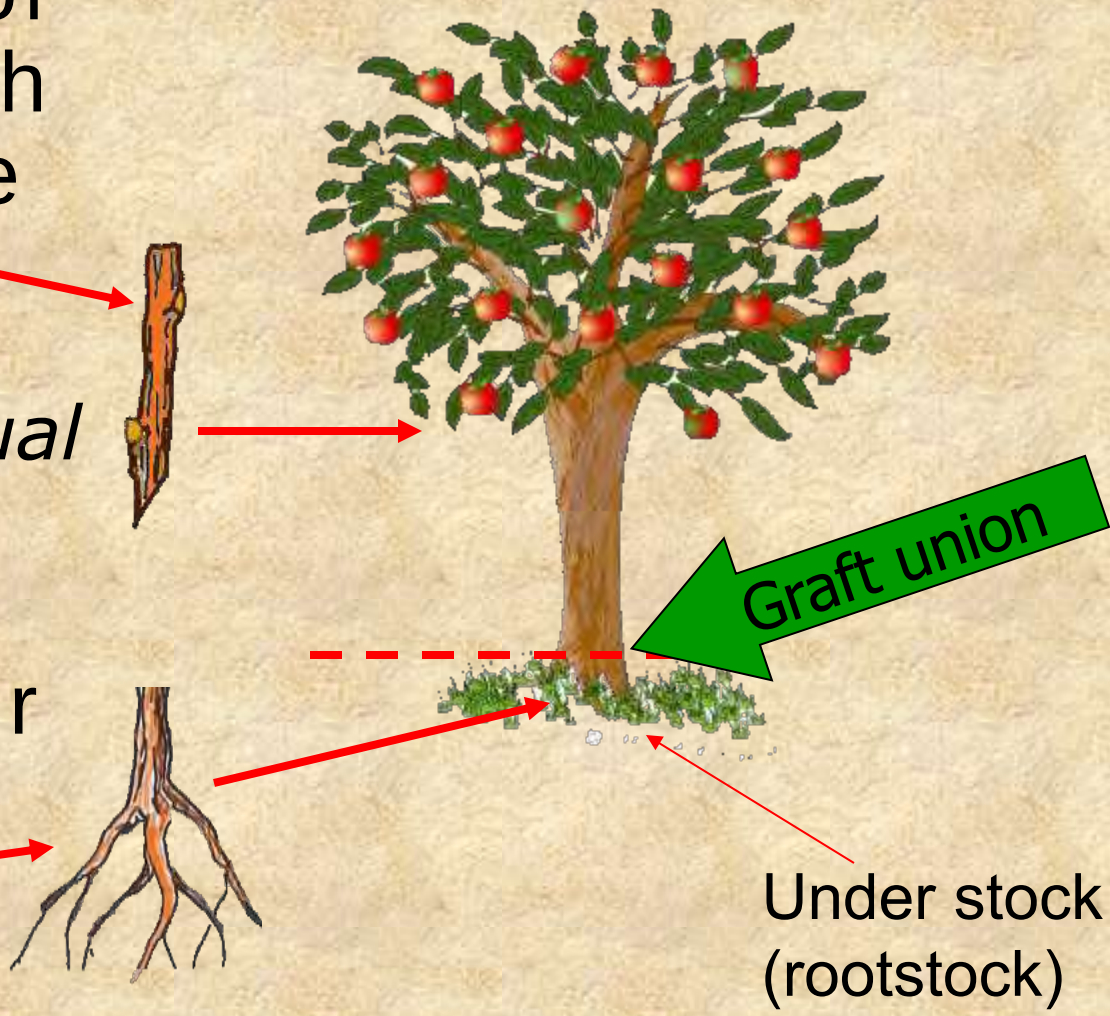
Rootstock



- **Grafting-**the process of inserting a part of one plant into or on another in a way that they will unite and continue growth as a single unit.

What is Scion Wood?

- **Scion**—A piece of last year's growth with two or three buds *(genetic material for* ***vegetative****—asexual propagation***)**; the part inserted on the understock or what we will call rootstock.



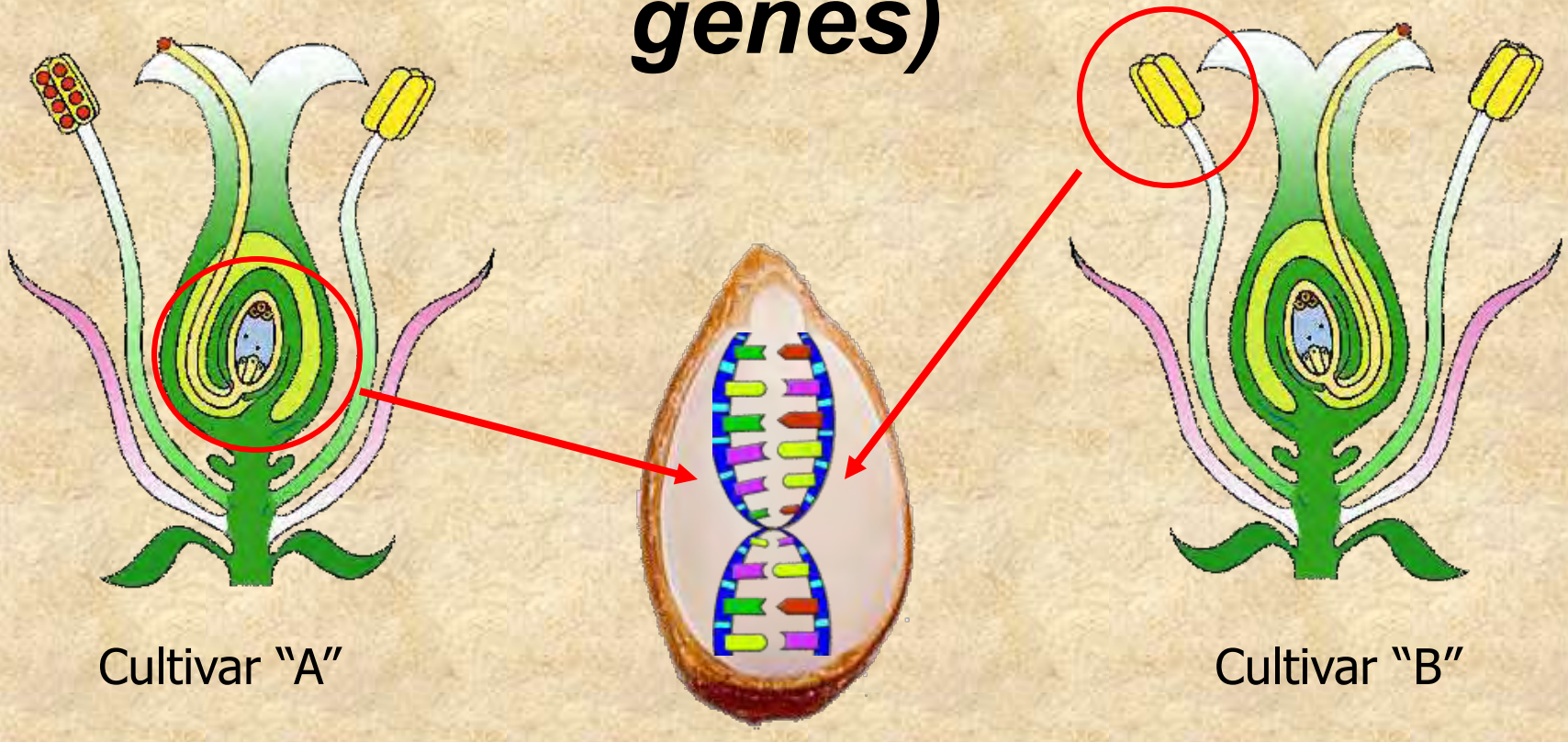
Why is it necessary to <u>vegetatively</u> propagate most tree fruit and nut cultivars by grafting (or budding)?

- **Vegetative (Asexual)** propagation maintains the genetic identity of the offspring

Scion: A detached shoot or twig containing buds from a woody plant, used in grafting. Alternate definition: A descendant; an heir; as, a scion of a royal stock.

- Trees are grafted (or budded) because they are often **difficult to root** or
- they **benefit from characteristics** of the rootstock variety.

Sexual propagation…(its all in the genes)



Cultivar "A"

Cultivar "B"

.. allows for genetic ***mixing*** and ***recombination*** that requires a number of steps for diploid parents. ..They must first form haploid gametocytes, and that means their diploid chromosomes must partition themselves into two sets. ..This partitioning can be called genetic **segregation**.

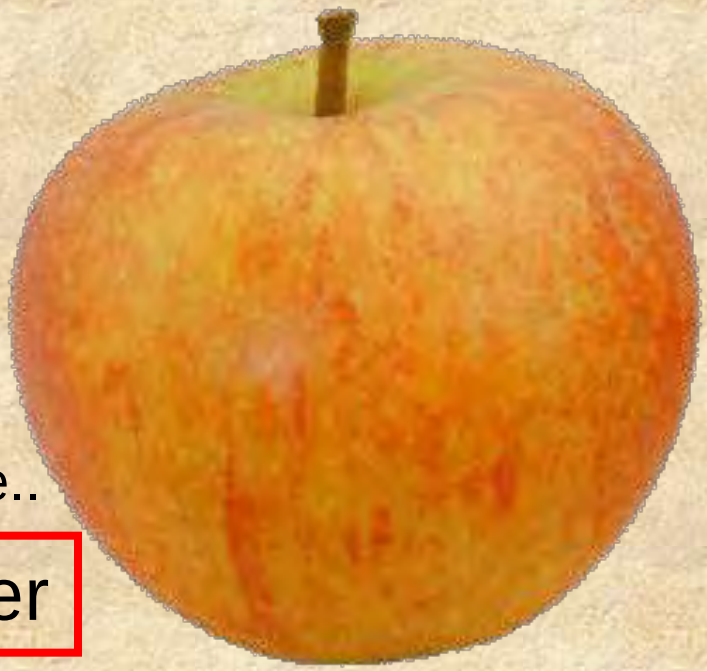
Genetic mixing and Recombination Result in many prodigeny… That do not…

resumble the parents, they may be…

Either

or

Dog



Only a Few are..

Winner

It takes a tremendous amount of time, effort, and screening process to determine whether one of out of thousands or more resultant prodigies is discarded (a dog) or of commercial value (a winner).

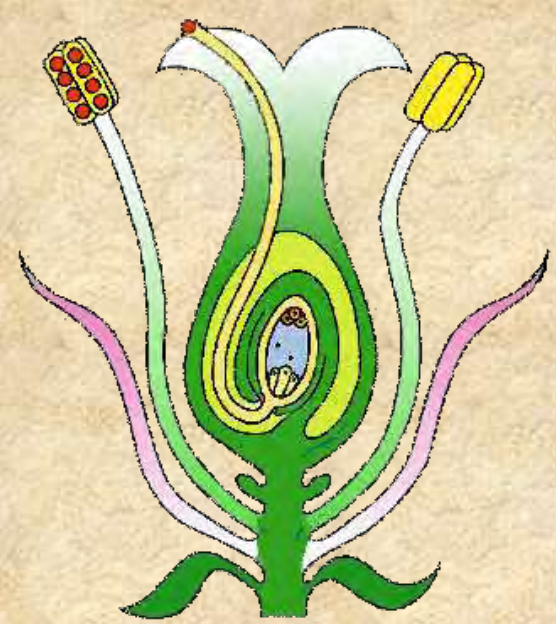
Honeycrisp

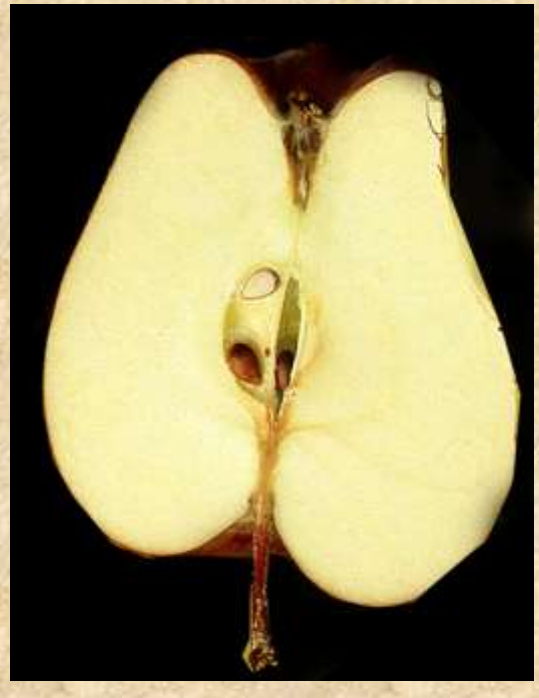
Dog or winner

- **Honeycrisp** (Malus domestica 'Honeycrisp') is an apple cultivar developed at the Minnesota Agricultural Experiment Station's Horticultural Research Center.
- Released in 1991, the Honeycrisp, once slated to be discarded, has rapidly become a prized commercial commodity.
- The Horticultural Research Center indicated that the Honeycrisp was a hybrid of the apple cultivars **Macoun** and **Honeygold**.
- However, genetic fingerprinting determined that neither of these cultivars is a parent of the Honeycrisp, but that **Keepsake** is one of the parents. The other parent has not been identified, but it might be a numbered selection that could have been discarded since.

Pome fruit

Pome: The fruit type derived from the fusion of the ovaries, calyx cup, and floral tube, produced by the apple, pear, quince, and other members of the subfamily Pomoideae.





Apple trees are monoecious--having male and female reproductive organs on the same plant.

A Brief History of Apples

- It is generally believed that the edible apple originated somewhere in Central Asia.
- It is a member of the *Rosaceae* (rose) Family, and is designated by the scientific name *Malus domestica*.

- The apples we eat today is a small population of a single species still growing in on the northern slopes of the mountains at the border of northwest China and the former Soviet Republic of Kazakhstan.

Three Pear Species

Three species account for the vast majority of edible fruit production;

1. the **European pear** Pyrus communis subsp. Communis cultivated mainly in Europe and North America,

2. the **Nashi pear** Pyrus pyrifolia (also known as Asian pear or apple pear), both grown mainly in eastern Asia.
3. the **Chinese white pear** (bai li) Pyrus ×bretschneideri,

There are thousands of cultivars of these three species. Which originated from Western China.

Pear rootstock: OHxF 97 A clonal rootstock of Old Home x Farmingdale which produces a full-size pear tree. It is more precocious than seedling, is winter hardy, resistant to fire blight and pear decline. It is also compatible with most varieties. It can be maintained at 15-17'.

The Paragon Pear

- A hybrid of 'Doyenne du Comice' and 'Max Red Bartlett'. A product of the pear breeding program at the Southern Oregon Experiment Station in Talent, Oregon.
- At least two trees were grafted and moved to the present Hanley Road site. The tree is late blooming with Bosc.
- The high quality fruit was first noted by the Agronomist John Yungen who noted how well it kept on the tree and the lack of core breakdown.

Cultivar is a label that denotes…

expectation of:

- Use & Flavor- sweet, tart
- Flowering and pollination-
- Disease resistance
  - mildew,
  - apple scab
- Fruiting-

Annual vs biennial

Season of harvest

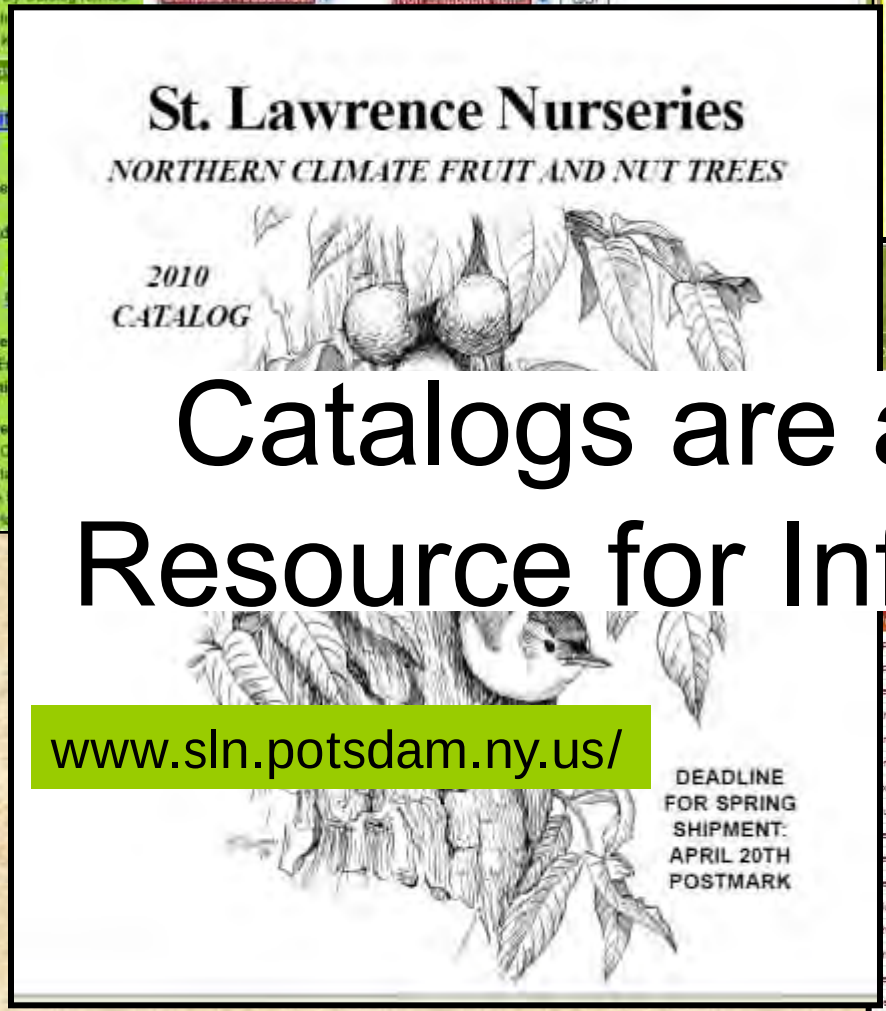
- July August September October

Pollination

Apple Scab

www.raintreenursery.com/

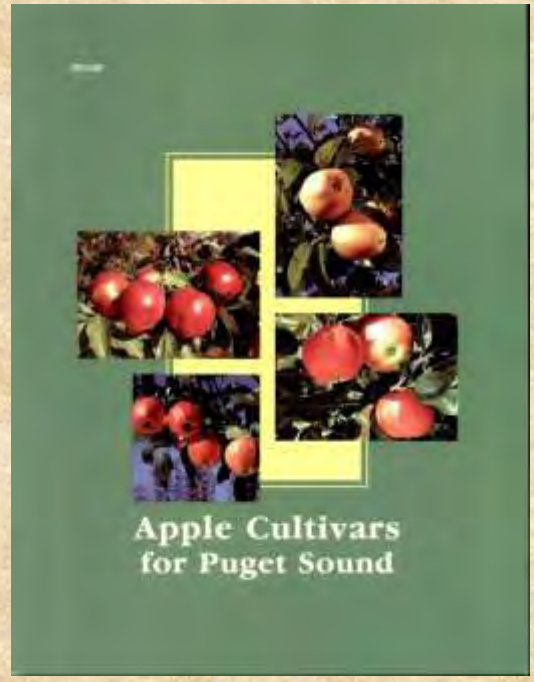
www.millernurseries.com/

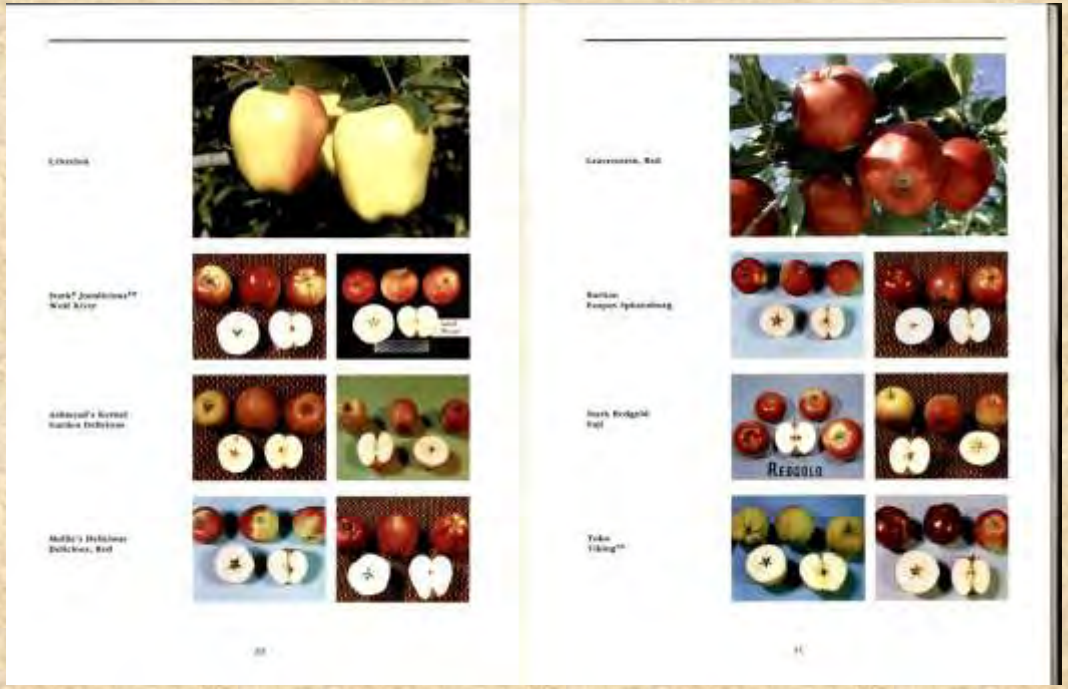


www.sln.potsdam.ny.us/

www.starkbros.com/

Catalogs are a Great Resource for Information



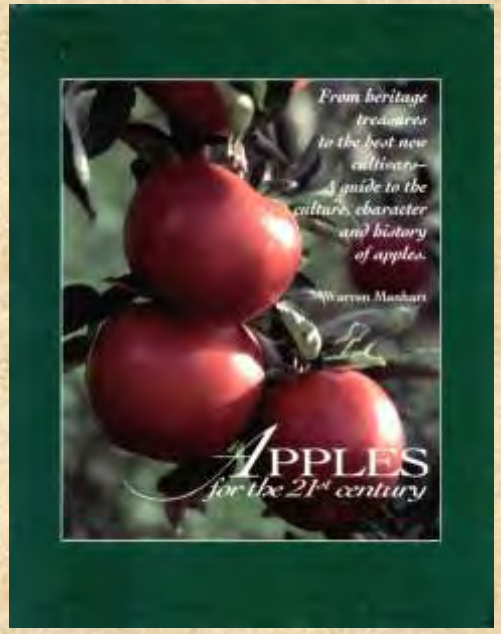


- **Apple Cultivars for Puget Sound (EB 1436)**
  Bloom and harvest dates, scab and mildew ratings, general descriptions and photographs.

http://cru84.cahe.wsu.edu/cgi-bin/pubs/EB1436.html

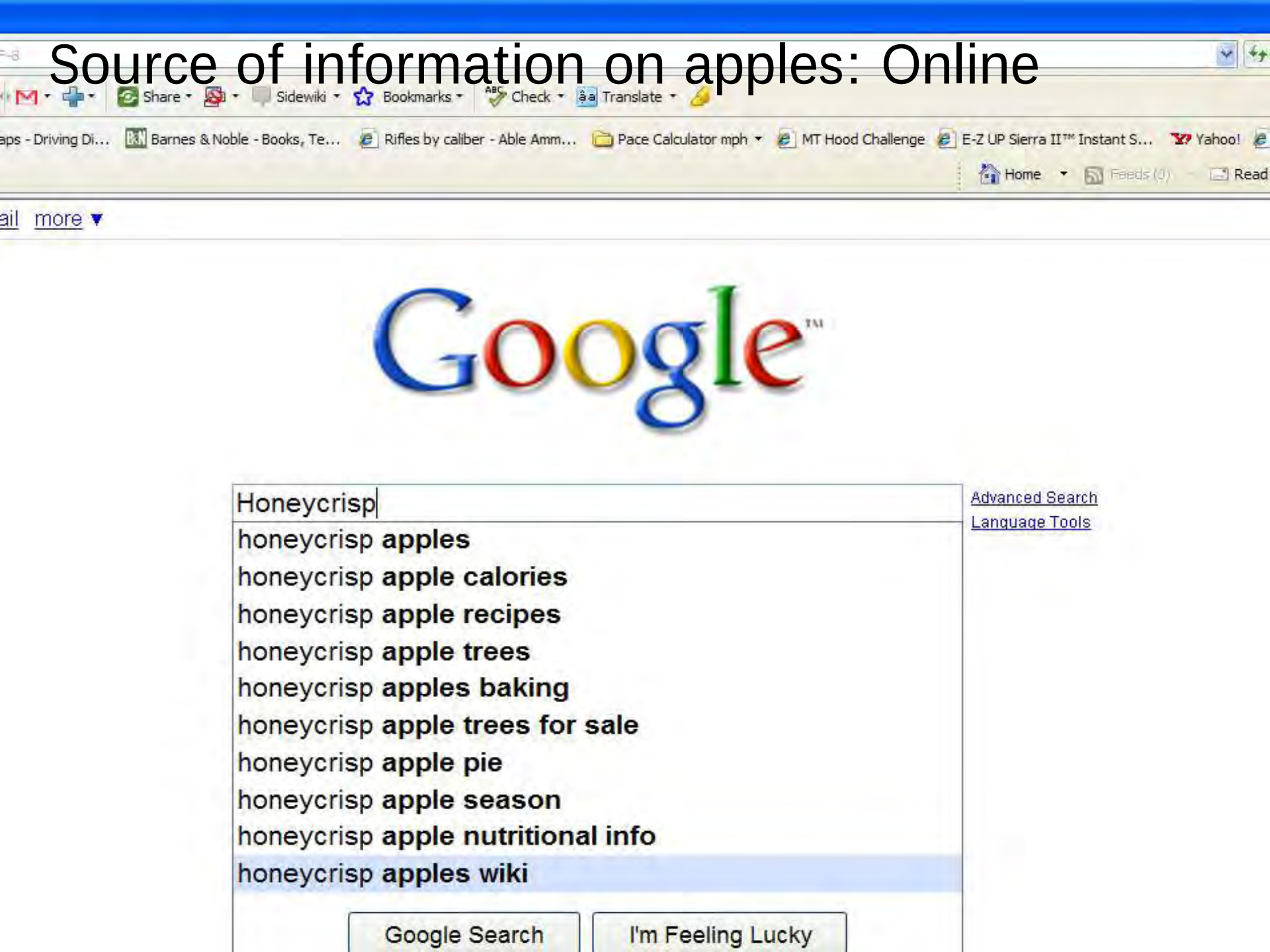
Warren Manhart's Four Favorite Apples

(from a list of 50 top cultivars)

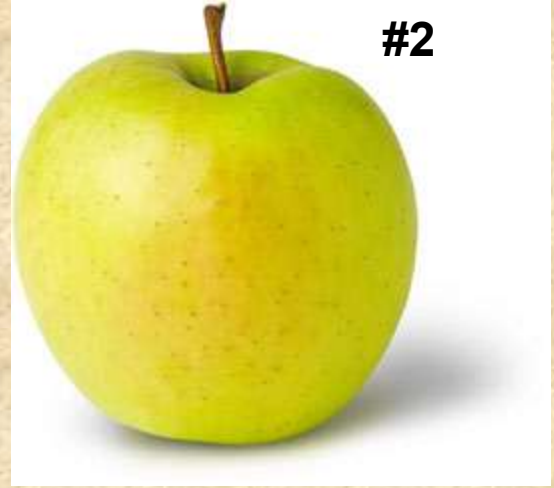


- **Elstar:** All purpose apple
- **Spitzenberg:** "Very good to best."
- **Braeburn:** Best of newer late apples.
- **Newtown:** Rated the highest of all.

Source of information on apples: Online



Source of information on apples: local markets



The five most popular apples in the United States are:

Red Delicious,
Golden Delicious,
Gala,
Fuji and
Granny Smith.

Apple Cultivars Moving Up

Jonagold

Honeycrisp

Braeburn

Pink Lady

Cameo

Heirloom Varieties

Arkansas Black

Newtown Pippen

Spitzenberg

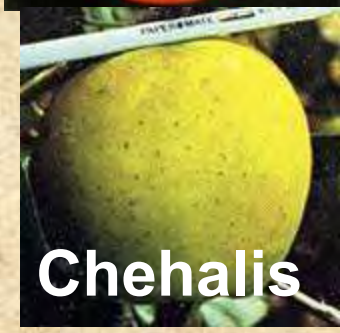
Northern Spy

Jonathan

Cox Orange

Disease Resistance and Good Quality

- Cultivars that have shown good resistance and good quality are: 'Akane’, 'Chehalis', 'Liberty', ‘Dayton', and ‘Redfree'.
- Intermediate resistance: 'Jonagold', 'Macoun', 'Melrose', 'Spartan', 'King'.



Cider Apples

Cider quality inevitably depends on the type of apple used. Cider is traditionally made with one third each of sweet, bittersweet, and sharp apples.

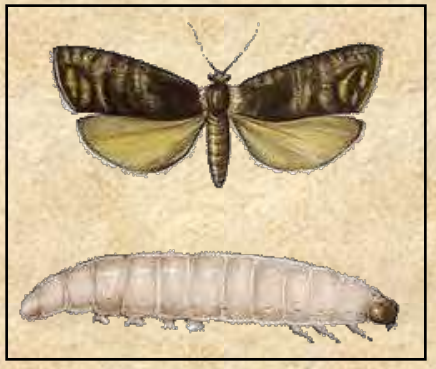
<u>Bittersweet</u>
Dabinette
Kingston Black
Michelin
Yarlington Mill

<u>Sharp</u>
Duchess
Melrose
Rhode I. Greening

<u>Sweet</u>
Cox's Orange Pippin
Gravenstein
Pitmaston Pineapple
Newtown Pippin

Apples and.... ,,,,Their Use	Fresh	Salad	Bake	Pie	Dried	Sauce	Bloom
Belle de Boskoop			X	X		X	Late-mid
Breaburn	X		X	X		X	Early-mid
Bramley's Seedling			X	X		X	Late
Cortland (Redcort)	X	X	X	X		X	Mid-season
Elstar	X	X	X	X		X	Mid-season
Empire	X	X	X	X		X	Early
Fuji (Beni Shogun)	X	X	X	X		X	Late-mid
Gala	X	X	X	X	X	X	Mid-season
Ginger Gold	X	X	X			X	Mid-season
Golden Delicious	X	X	X	X		X	Late-mid
Gravenstein	X		X	X		X	Early
Haralred	X		X	X	X	X	Early-mid
Honeycrisp	X	X	X	X	X	X	Late-mid
Jonagold, Jonagored	X	X	X	X		X	Mid-season
Jonamac	X		X				Early
McIntosh	X	X		X		X	Early
Melrose	X	X	X	X		X	Mid-late
Paula Red	X	X	X	X		X	Early-mid
Pristine	X		X	X		X	Early-mid
Queen Cox	X		X	X		X	Late-mid
Redfree	X			X	X		Mid-season
Spartan	X	X		X		X	Mid-season
Spitzenberg	X	X	X	X		X	Early-mid
Wealthy	X		X	X		X	Early-mid
Wolf River	X		X		X	X	Mid-season
Zestar	X		X			X	Early-mid

Seeds are important



June Drop: The more seeds in a particular apple, the more hormones produced on the tree. By the end of June, the tree reaches a tipping point, where in the period of about ten days, it drops the smallest and weakest remaining fruits, which are the ones with the least number of seeds.

Codling moth larvae burrows into the fruit, eats for around three weeks, then leaves the fruit to overwinter and pupate elsewhere. Most nourishment is obtained by feeding on the proteinacous seeds. When the seeds are destroyed the wormy apples drop early.

Pollination

- The apple, *Malus domestica*, is considered to be **self-unfruitful**.
- All apple cultivars (varieties) require the pollen of a different cultivar to set a crop of fruit.
- A **pollen source** and **transfer** must be provided for these cultivars.

Pollination

Cultivar A

Pollinator

Compatible pollen source

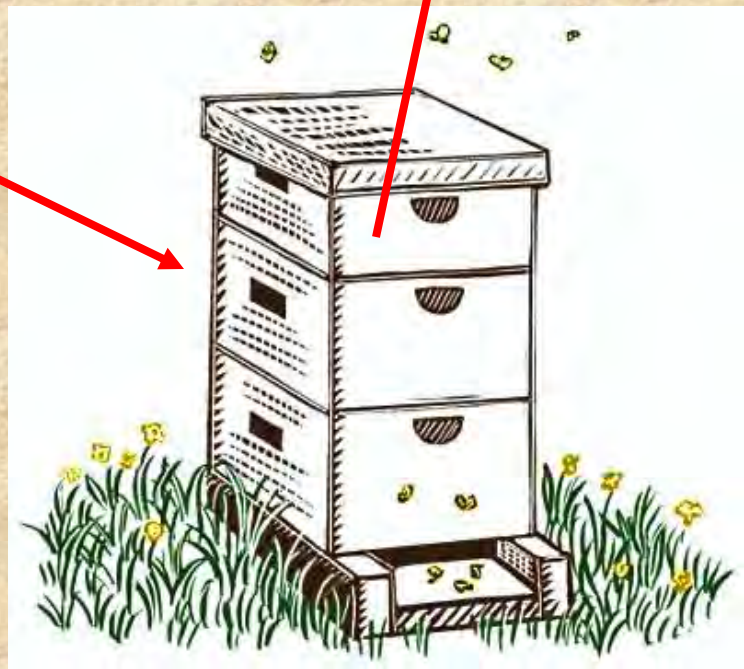
Cultivar B

Self incompatible verses self pollination

Diploid = two sets of chromosomes

Triploid = three sets of chromosomes

Pollen sterile: Triploid will not fertilize diploid cultivars—Diploids (normal) will fertilize triploids.



Other Pollinators or Transfer Agents

Blue Orchard bee
(Mason bee)

Bumble bee

Hover fly

Apple Bloom & Pollination

Pollen source

Variety Pollinated

Variety Pollinated	Gravenstein	Zestar	Roxbury Russet	Akane	Pristine	Silken	Paulared	Chehalis	Red Wealthy	Discovery	Jonagold	Rebella	Resi	Red Boskoop	Shizuka	Ginger Gold	Greensleeves	Dayton	Rajka	Rleika	September Wonder	Red Cort	Tydeman's Early	Sansa	Gala	Honeycrisp	Golden Delicious	Queen's Cox	Gold Star	King	Bramley's
Early bloom																															
Gravenstein	■										■			■	■															■	■
Zestar	■	■									■			■	■															■	■
Mid-season bloom																															
Roxbury Russet	■		■								■			■	■															■	■
Akane	■			■							■			■	■															■	■
Pristine	■				■						■			■	■															■	■
Silken	■					■					■			■	■															■	■
Paulared	■						■				■			■	■															■	■
Chehalis	■							■			■			■	■															■	■
Red Wealthy	■								■		■			■	■															■	■
Discovery	■									■	■			■	■															■	■
Jonagold	■										■			■	■															■	■
Rebella	■										■	■		■	■															■	■
Resi	■										■		■	■	■															■	■
Red Boskoop	■										■			■	■															■	■
Shizuka	■										■			■	■															■	■
Ginger Gold	■										■			■	■	■														■	■
Greensleeves	■										■			■	■		■													■	■
Dayton	■										■			■	■			■												■	■
Rajka	■										■			■	■				■											■	■
Releika	■										■			■	■					■										■	■
September Wonder	■										■			■	■						■									■	■
Red Cort	■										■			■	■							■								■	■
Tydeman's Early	■										■			■	■								■							■	■
Sansa	■										■			■	■									■						■	■
Gala	■										■			■	■										■					■	■
Honeycrisp	■										■			■	■											■				■	■
Golden Delicious	■										■			■	■												■			■	■
Queen Cox	■										■			■	■													■		■	■
Gold Star	■										■			■	■														■	■	■
Late																															
King	■	■	■	■	■	■	■	■	■	■	■			■	■															■	■
Bramley's	■	■	■	■	■	■	■	■	■	■	■			■	■															■	■

		July				August						Sept						October						Nov.		
	Variety	15	20	25	30	5	10	15	20	25	30	5	10	15	20	25	30	5	10	15	20	25	30	5	10	15
1	Lodi T^3	X	X																							
2	Centennial T^2		X	X																						
3	Pristine T^2			X	X	X																				
4	Gravenstein T^3						X	X																		
5	Ginger Gold T^2						X	X	X																	
6	Gala								X	X	X															
7	Queen Cox T^2									X	X	X														
8	Paulared T^2										X	X	X													
9	Wealthy T^1										X	X	X													
10	Honeycrisp T^2												X	X	X											
11	Elstar T^2													X	X											
12	Golden Delicious T^2														X	X	X									
13	Red Delicious, T^2															X	X	X								
14	Beni Shogun T^2															X	X	X								
15	Empire, Crown T^2																X	X	X							
16	Haralred T^1																	X	X	X						
17	Melrose, Spur T^2																	X	X	X						
18	Spitzenburg T^2																		X	X						
19	Cameo T^2																		X	X	X					
20	York, Spur T^1																		X	X	X					
21	Taylor Spur Rome T^2																		X	X	X					
22	Yellow Newtown Pippin																			X	X	X				
23	Braeburn, Kumeu T^2																				X	X				
24	Pink Lady T^2																					X	X	X		
25	Granny Smith, T^2																					X	X	X		

Picking and Storing Apples

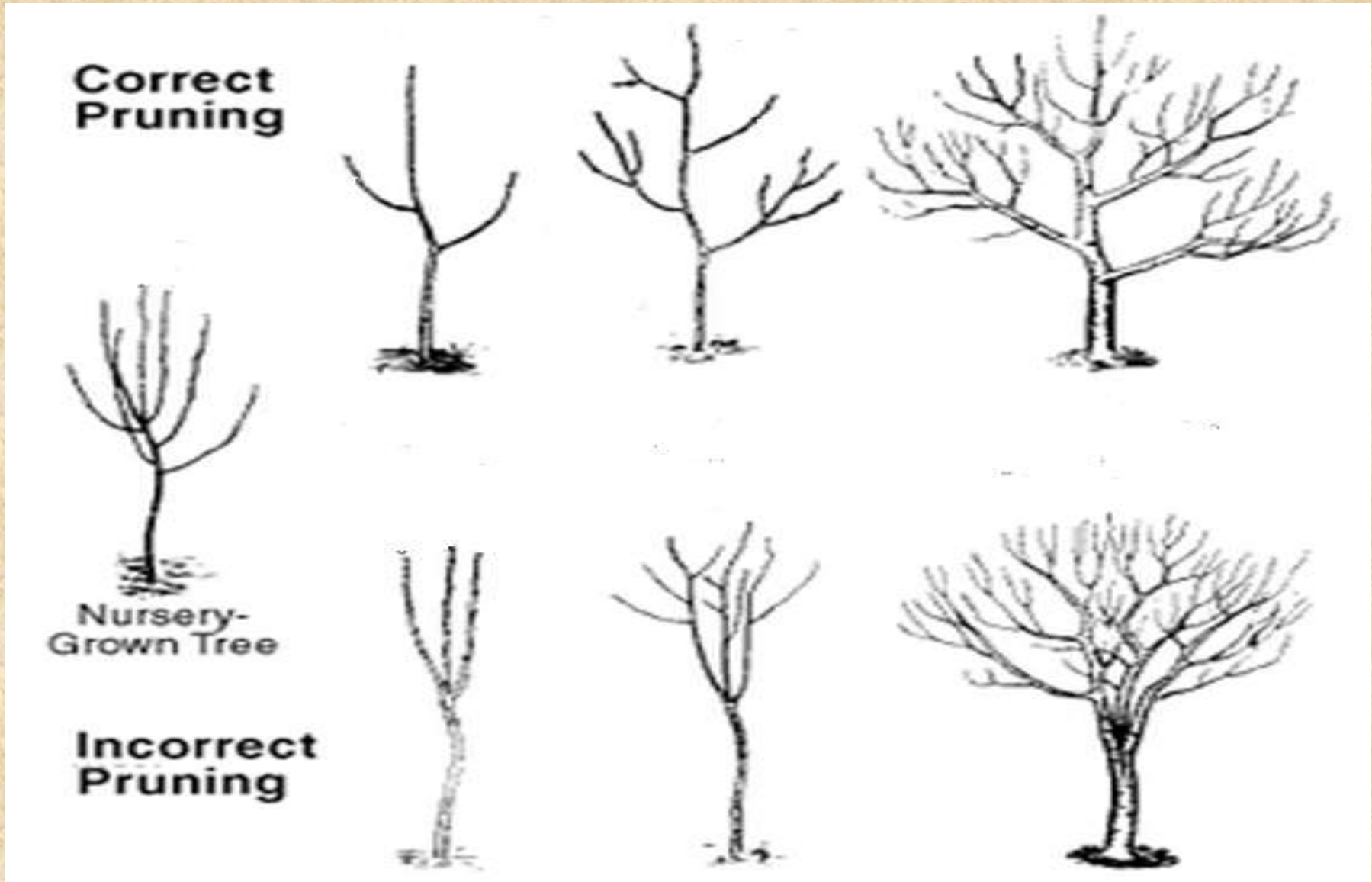
FS 147

***Early*--Jackson County, Milton-Freewater, and Wasco**
***Midseason*--Lower Hood River, Malheur, Douglas County, and Josephine County**
***Mid- to late*--Willamette Valley**
***Late*--high mountains and plateaus and the coast.**
Early districts often begin harvest about 10 days earlier than midseason districts, and late-season districts about 10 days later.

Table 1.—Maturity dates for apples in the midseason districts.

Variety	Dates	Skin color when mature
Yellow Transparent	July 10–25	Creamy yellow
Lodi	July 15–30	Creamy yellow
Chehalis	Aug. 20–30	Yellow
Gravenstein	Aug. 20–25	Yellow with red
Tydeman's Red	Aug. 25–30	Red
Prime Red	Aug. 20–30	Red
Gala	Sept. 1–15	Yellow with red stripes
Red Wealthy	Sept. 10–20	Yellow with red
Jonagold	Sept. 15–Oct. 7	Yellow with red stripes
Elstar	Sept. 17–24	Yellow with red stripes
Arlet	Sept. 17–30	Red
McIntosh	Sept. 20–30	Yellow with red blush
King	Sept. 15–25	Yellow with red blush
Jonathan	Sept. 20–25	Yellow with red blush
Liberty	Sept. 20–Oct. 8	Mostly red
Grimes Golden	Sept. 25–Oct. 5	Yellow
Empire	Sept. 27–Oct 7	Red stripes
Golden Delicious	Oct. 1–15	Yellow
Spartan	Oct. 1–10	Red
Delicious—red strains	Oct. 1–15	Red
Spitzenburg	Oct. 5–20	Yellow with red stripes
Winter Banana	Oct. 5–20	Yellow
Braeburn	Oct. 10–25	Red stripes
Melrose	Oct. 15–30	Red stripes
Fuji	Oct. 15–Nov. 1	Red
Winesap	Oct. 20–25	Red
Rome Beauty—red strains	Oct. 25–Nov. 10	Red
Northern Spy	Nov. 5–15	Yellow with red stripes
Yellow Newtown	Nov. 10–20	Green
Granny Smith	Nov. 10–20	Green

Cultivars Selected on Tree Growth & Structure



Influence of Tree Structure

- Sunlight is critical to tree growth and cropping.
- Photosynthetic products are required for vegetative growth, fruit set, fruit growth, fruit color, and flower bud initiation and development.
- Tree size, shape, and density greatly influence the distribution of light through the tree canopy.

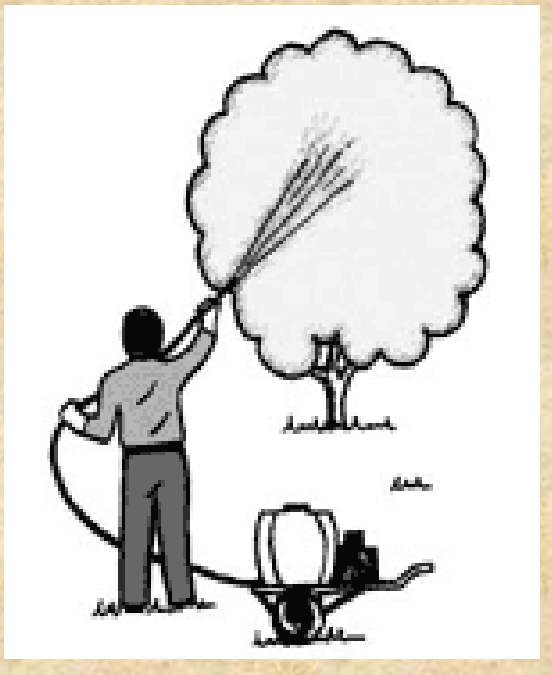
Spur-type strains

- Spur-type strains of certain varieties such as Delicious, Golden Delicious, and others are available.
- Spur types are smaller, especially on dwarfing root stocks, and they're often more productive than nonspur types.

http://www.homeorchardsociety.org/ebooks/samples/Apple_Fruiting_Sample.pdf

Semi-dwarf and Dwarf Trees

There is an increasing interest in smaller fruit trees for several reasons:



- Semi-dwarf and dwarf trees have the additional advantage of being easier to prune, spray, thin, and harvest.

Tree and Rootstock vigor

Rootstock

Scion wood

Rootstock		Very Low Vigor	Low Vigor	Moderately Vigorous	Vigorous	Very Vigorous
				Delicious Golden Jonathan Akane Criterion Empire Spur Winter Banana		Gravenstein Mutsu Jonadel Spencer Winter Banana
		Spur Rome Super Spur Delicious Spur Winesap	Spur Delicious Spur Golden Spur Granny Smith		Jonagold Cortland Granny Smith	
Very Dwarf	M 27	N.R.*	N.R.*	N.R.*	N.R.*	1(?)
Dwarf	EM 9	N.R.*	N.R.*	1	1,2	2
	M 26	1,2	1,2	2,3	3,4	4,5
	MAC 9	1,2	1,2	2,3	3,4	4,5
Semi-Dwarf	EM 7	2	2,3	4	4,5	5
	M 7a	2	2,3	4	4,5	5
	EMLA 7	2	2,3	4	4,5	5
Moderately Vigorous	MM 106	2	3	4,5	5	5,6
	EM 4	2	3	4,5	5	5,6
	EM 2	2	3	4,5	5	5,6
	MM 111	2	3	4,5	5	5,6
	Interstem 9 on very vigorous root	2,3	3	4,5	5	5
Vigorous	EM 1	3	3,4	5	5,6	6
	MM 104	3	3,4	5	5,6	6
Very Vigorous	Seedling	4	4,5	5	6	6+
	EM 16	4	4,5	5	6	6+
	Alnarp 2	4	4,5	5	6	6+

Estimated Tree Vigor for Apple Varieties

Ted Swensen

Many factors enter into the equation to determine tree size: rootstock, soil fertility, growth habit, and vigor.

HOS has printed much information on rootstocks and this is readily available. Soil fertility is a variable that must be taken into consideration, but each growth site is different. Growth habit deals with growing upright or spreading, spur or tip fruit bearing. HOS has an expanded publication of spur and tip bearing apples. Keep in mind that a spur bearing fruiting habit is more dwarfing than a nonspur bearing fruiting habit. Vigor refers to the growth of the variety that has been grafted onto a size controlling rootstock.

Predicting vigor is a rough estimate on how large the tree will grow on a particular rootstock. Over the years I have adopted in my subconscious mind to automatically calculates plus or minus 10% to numbers.

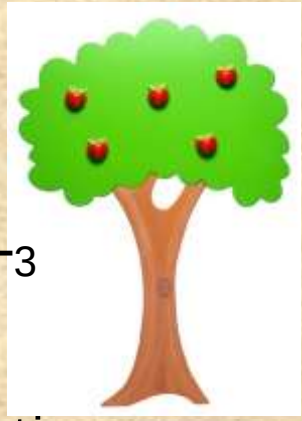
Ted Swensen adopted the symbols used in *The Book of Apples* by Joan Morgan and Alison Richards, published in association with the Brogdale Horticultural Trust, 1993.

T^1: Weak vigor varieties
T^2: Medium vigor varieties
T^3: Very vigorous varieties

Estimated Tree Vigor

T^1 

T^2 

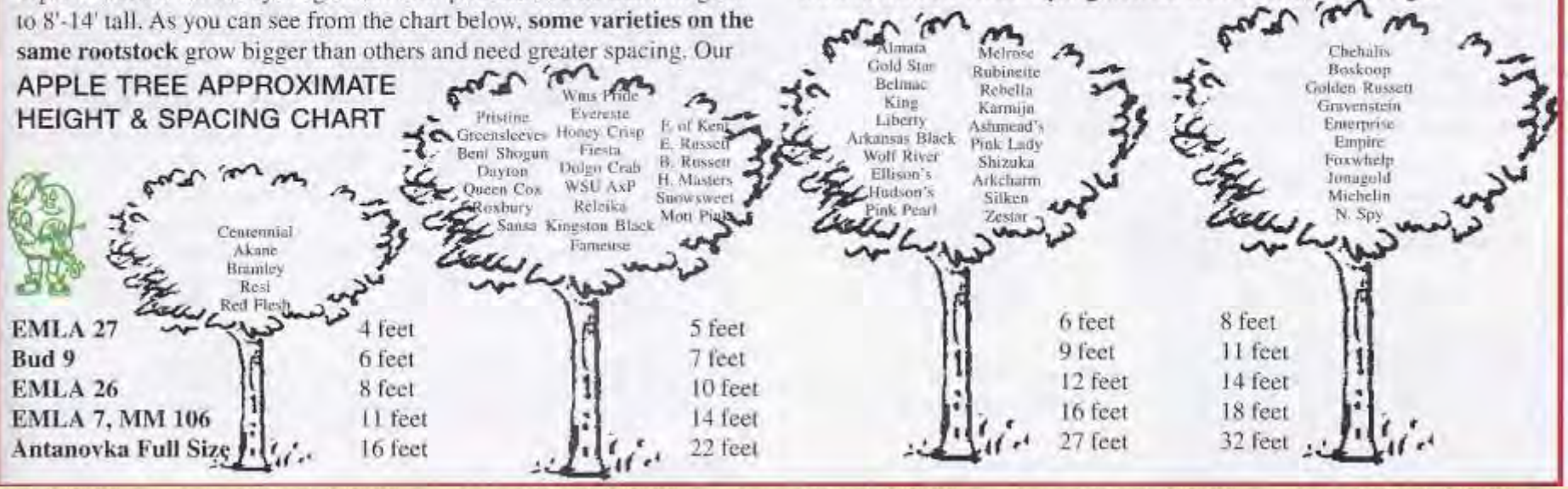
T^3 

- According to Ted, T^1: weak vigor varieties may not be suitable for the most dwarfing rootstocks. The tree will just be too small to produce.
- While T^2 medium vigor varieties (which are the most numerous) will be better suited to the more dwarfing rootstock.
- Next, the T^3 very vigorous varieties are ideal for the more dwarfing rootstocks. **When the data conflicted Ted chose the larger of the two**, he thought it would be better to be surprised with a smaller tree than a larger one.

ABOUT ROOTSTOCK & TREE SPACING

Most of our apple trees are grafted on the dwarfing EMLA 26 rootstock. (Check the rootstock available after each varietal description.) It is a superior choice for backyard growers and produces a tree that will grow to 8'-14' tall. As you can see from the chart below, **some varieties on the same rootstock** grow bigger than others and need greater spacing. Our rootstocks are winter hardy to USDA Zone 4 and tolerate a wide variety of soils. They induce heavy early fruit production and make a well anchored tree. Chart includes varieties for which data is available. The www.homeorchardsociety.org website lists 3,990 varieties vigor!

APPLE TREE APPROXIMATE HEIGHT & SPACING CHART

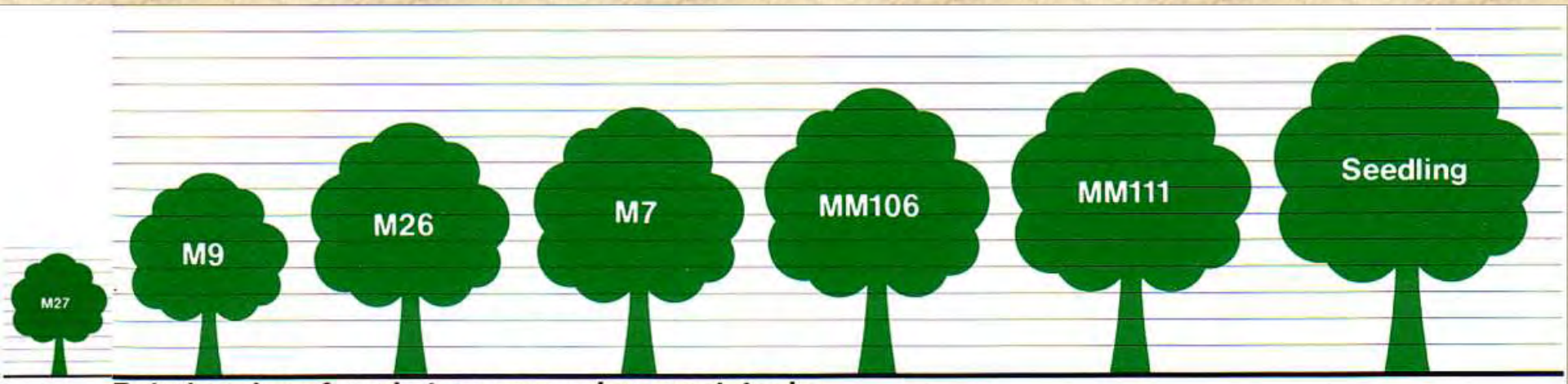


EMLA 27	4 feet	5 feet	6 feet	8 feet
Bud 9	6 feet	7 feet	9 feet	11 feet
EMLA 26	8 feet	10 feet	12 feet	14 feet
EMLA 7, MM 106	11 feet	14 feet	16 feet	18 feet
Antanovka Full Size	16 feet	22 feet	27 feet	32 feet

Centennial T[1]
Akane
Sansa
Wealthy
Greensleeves
Davey
Norland
Delcon
Winter Banana
York, Spur
Haralred
Sturmer Pippin
Kandil Sinap
Ortley
Freyberg
Goldjon
Wagener

Pristine T[2]
Cameo
Beni Shogun
Dayton
Queen Cox
Roxbury Russet
Evereste
Honeycrisp
Spitzenberg
Golden Delicious
Braeburn
Crown Empire
Alkmene
Swiss Gourmet
Taylor Spur Rome
Paulared
Dolgo Crabapple
Williams Pride
Ginger Gold
Fiesta

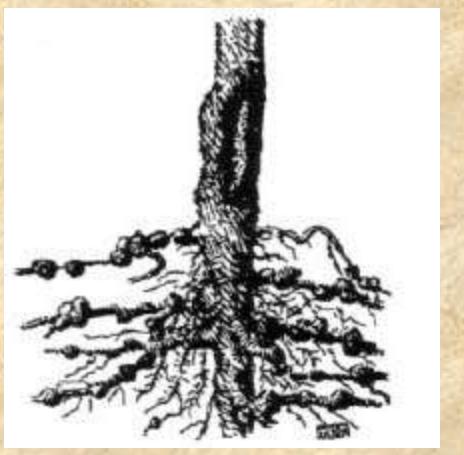
Apple Rootstock listed by size class Size

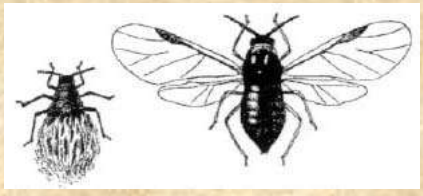


Relative size of apple trees on various rootstocks.

Class 1 P.22 **M 27** G.65	Size Class 3 **M.9** **Bud.9** P. 2 G.16	Size Class 5 G. 30	Size Class 7 **MM. 106** Bud. 490	Size Class 9 Bud. 118 P. 18
Size Class 2 Bud 146 Bud 491 P.16 Mark	Size Class 4 G. 11 **M. 26**	Size Class 6 **M. 7**	Size Class 8 **MM. 111**	Size Class 10 **Seedling**

Rootstock Selection





Woolly apple aphid

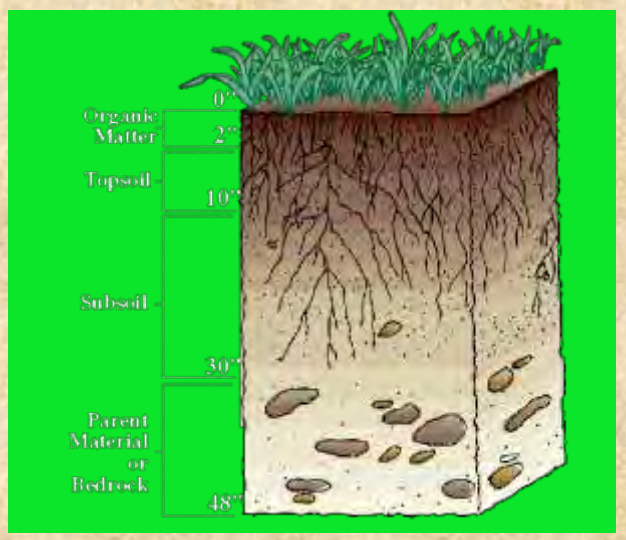
Selection on basis of :

- Dwarfing
- Precocious
- Disease &
- Insect resistance
- Soil type

Early fruiting

Scab fungi

Fire Blight



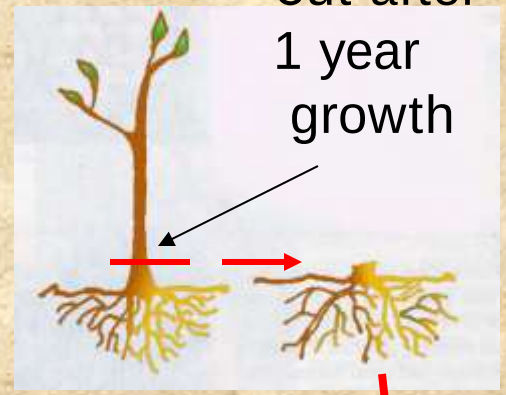
Soil site conditions

Propagating Rootstock

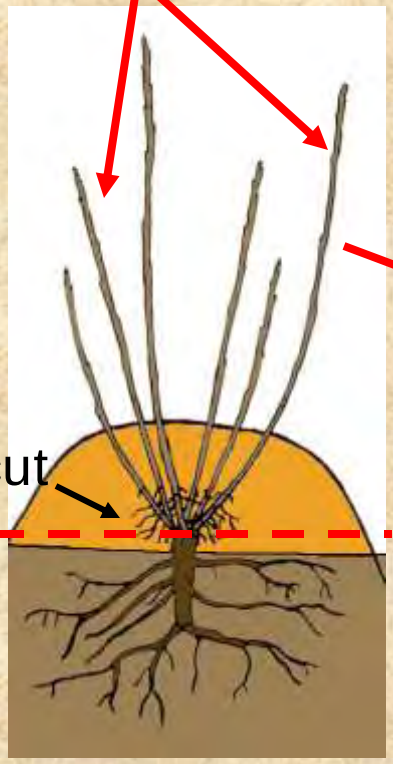
Rootstock also selected for: Ease of propagation

Harvest rooted whips

Cut after 1 year growth



Stoolbed



Under cut

Ready to be grafted

Mounded sawdust

Backyard

2nd summer's growth

Dormant season harvest of rooted whip

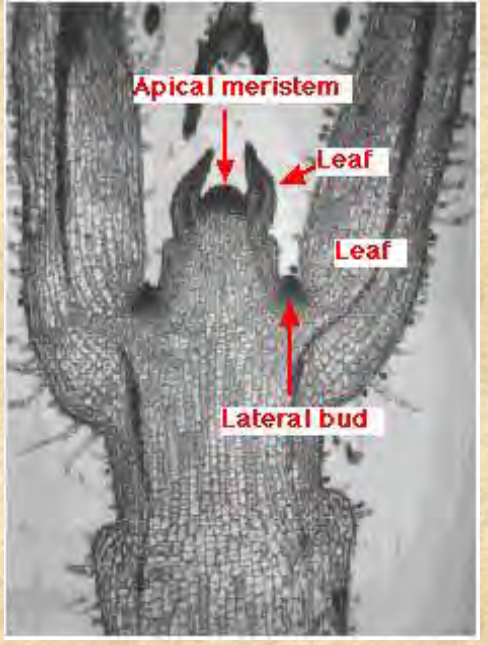
Graft Compatibility

Sufficiently close genetic relationship for the formation of a successful graft union

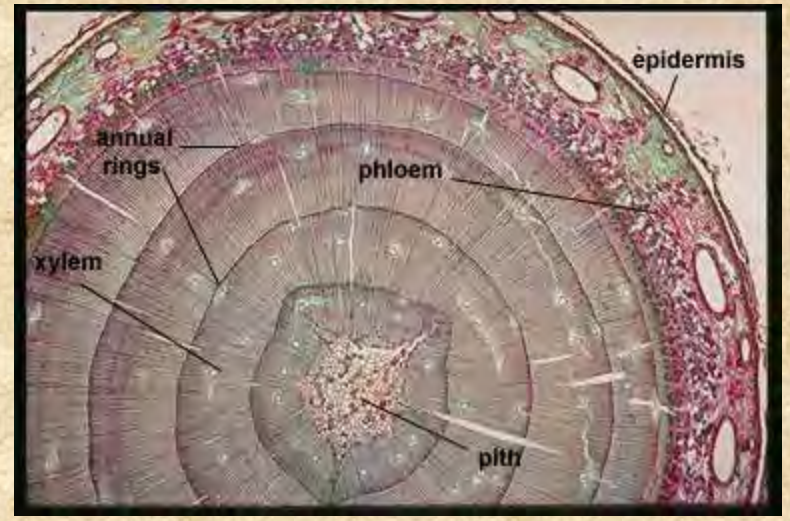
- Limits of Compatibility
  - Clone Species Genus Family Difficulty

Clone	Species	Genus	Family	Difficulty
S	S	S	S	No sweat
D	S	S	S	Easy
D	D	S	S	Moderate
D	D	D	S	Unlikely
D	D	D	D	Nill

Meristematic tissue



The main function of meristematic tissue is mitosis (cell division). The cells are small, thin-walled, with no central vacuole and no specialized features.

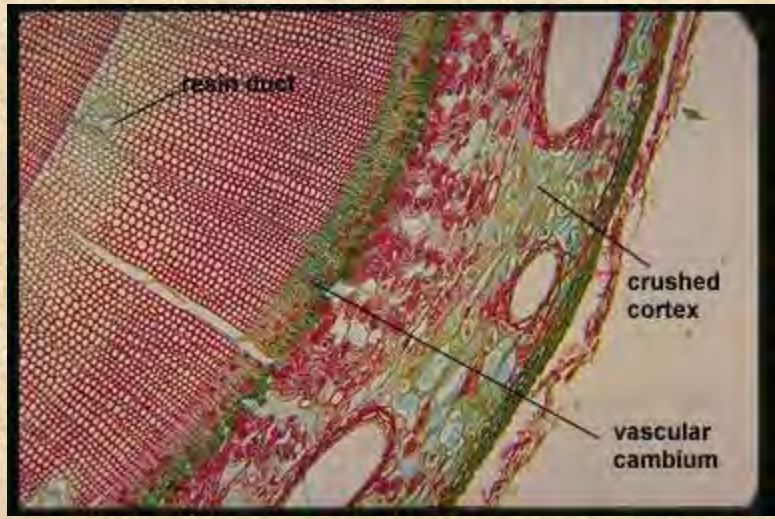


Fruit trees have extensive **lateral meristems** (the cambium, the vascular cambium, and the cork cambium) that give rise to growth in girth, also called **secondary growth**.

Their activity may fluctuate in the course of the year and is reflected by annual rings.

Formation of Secondary Meristems

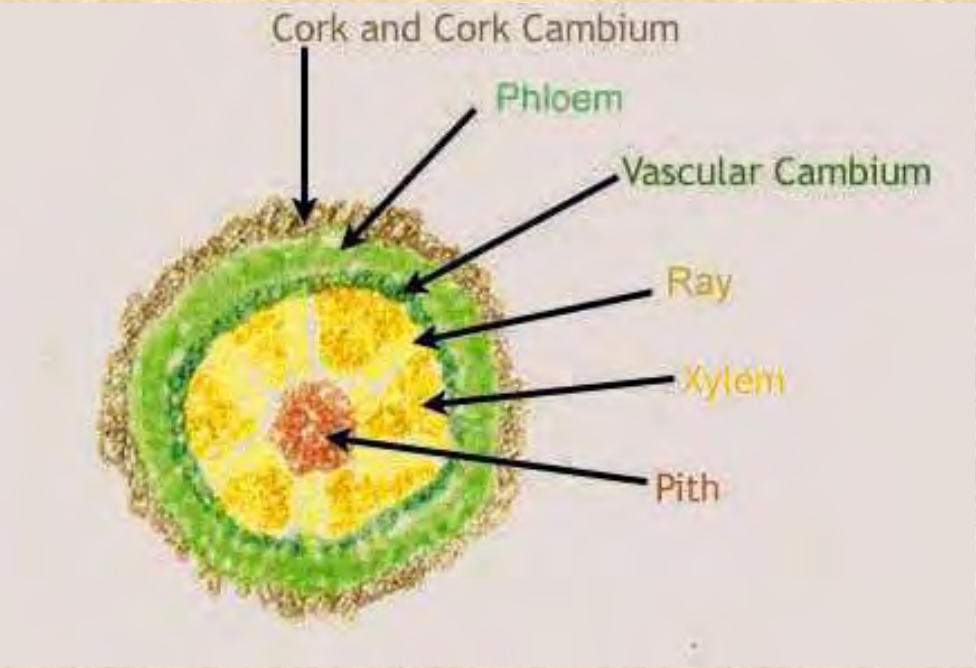
- The formation of **secondary meristems** shows that differentiated cells can reverse their state and go back to a meristematic existence.
- Their ability to divide is thus not lost, though it is not used unless an adjustment to changed circumstances requires it.
- **Those circumstances arises when the tree is injured, pruned, or cut to be grafted**.

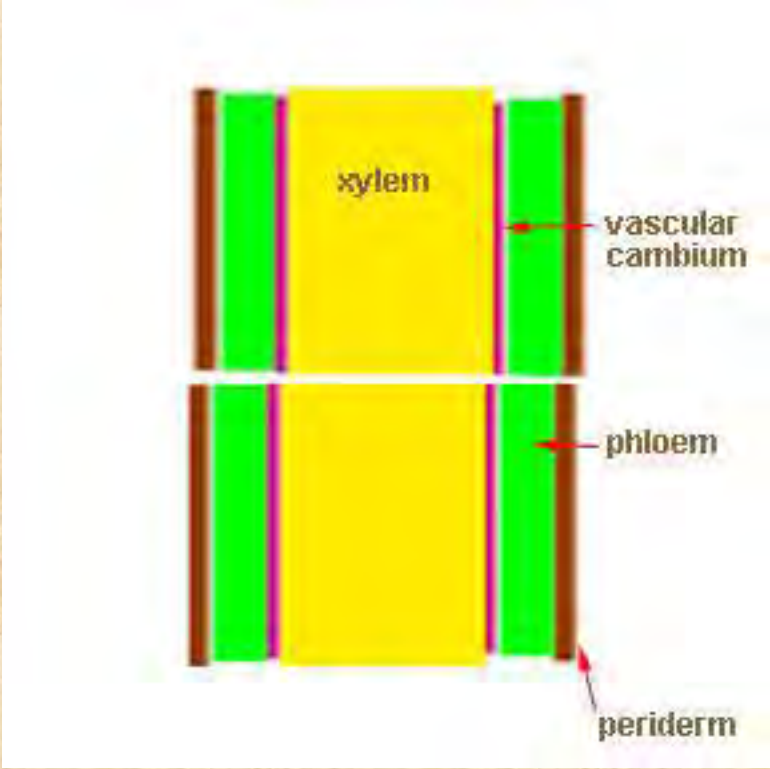


Differentiation of new cambium.

- Parenchyma cells **differentiate** into cambium cells, thus uniting the cambium of the stock with the cambium of the scion.
- Formation of secondary xylem and phloem from new cambium allows translocation between the stock and scion.

Cambium—

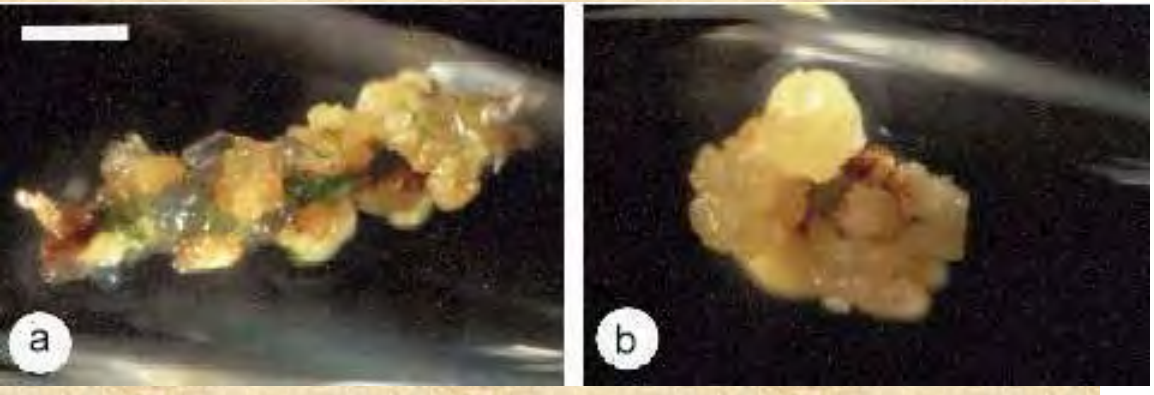


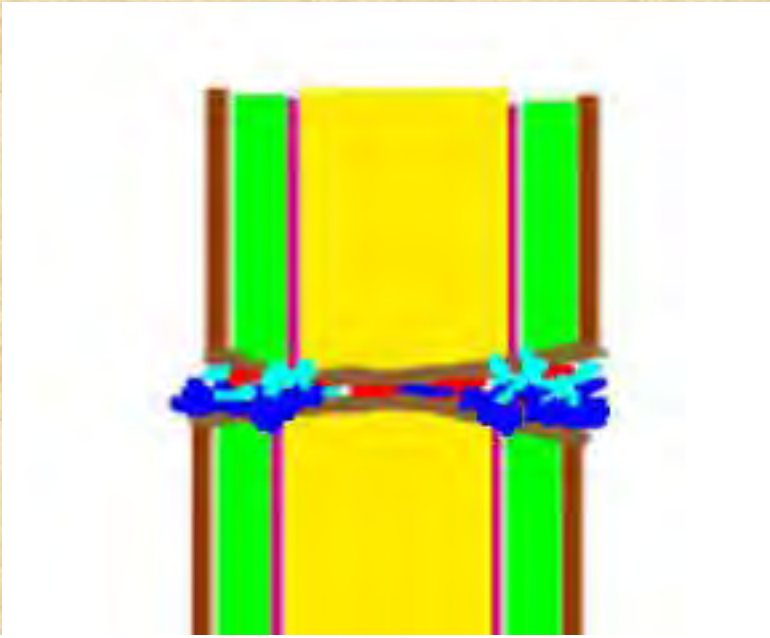


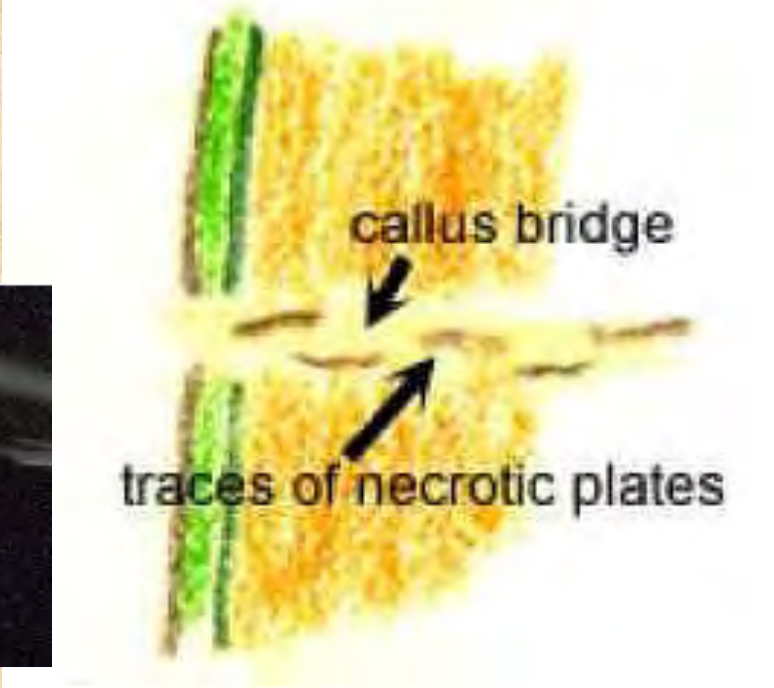
- The growing part of the tree; located between the wood and bark. At the season when bark separates freely, cambium will be both on the wood surface and on the inner bark.

Cambial Contact

- In the first days or weeks after the two parts to be grafted are cut, cells proliferate at the site of the cut. This tissue is called "callus".

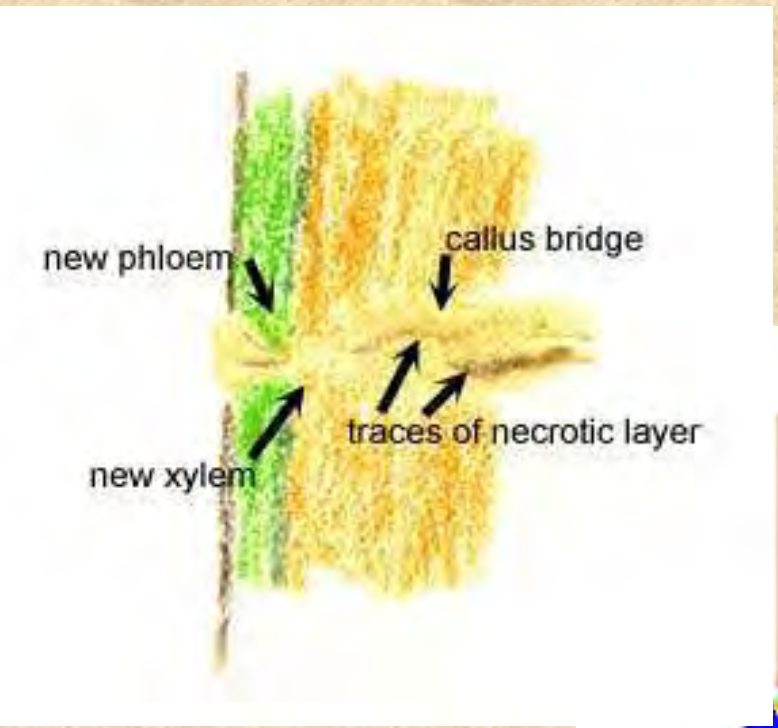


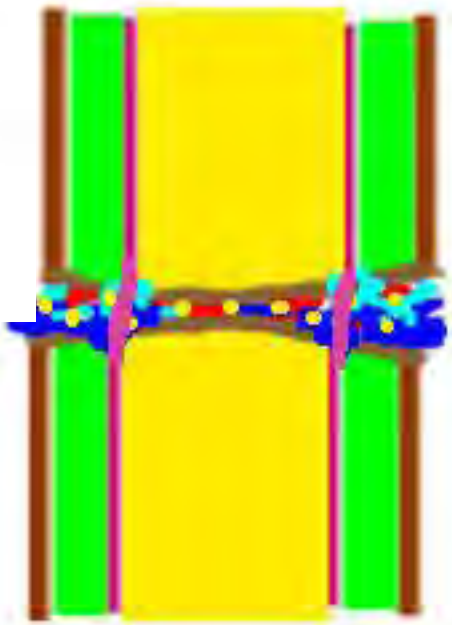


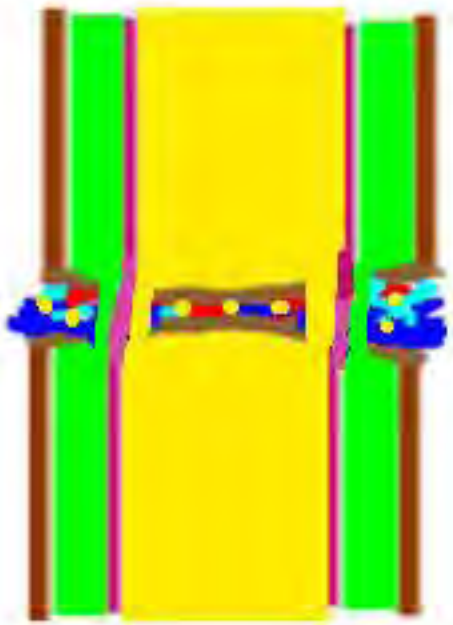


Callus Bridge

If the two parts are in ***contact*** with **pressure** between the parts these two callus layers will begin to grow together, creating a "callus bridge."







Avoidance of desiccation

1.) Management during cuts. Keep cut edges moist.

2.) Use budding & grafting tape---or

3.) Use budding & grafting bands.

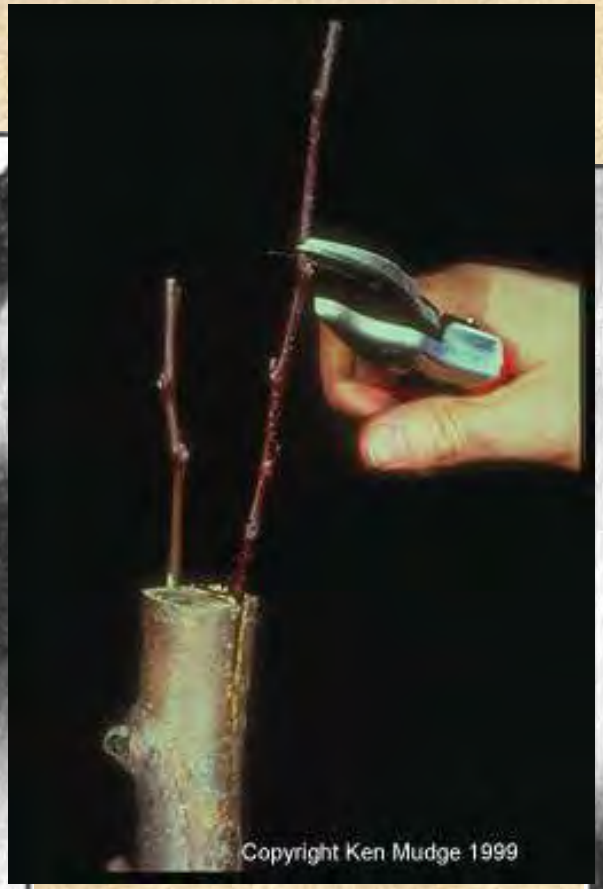
4.) Use tree seal

Wrap the splice cuts…

…firmly to create pressure and stability

Apply tree seal

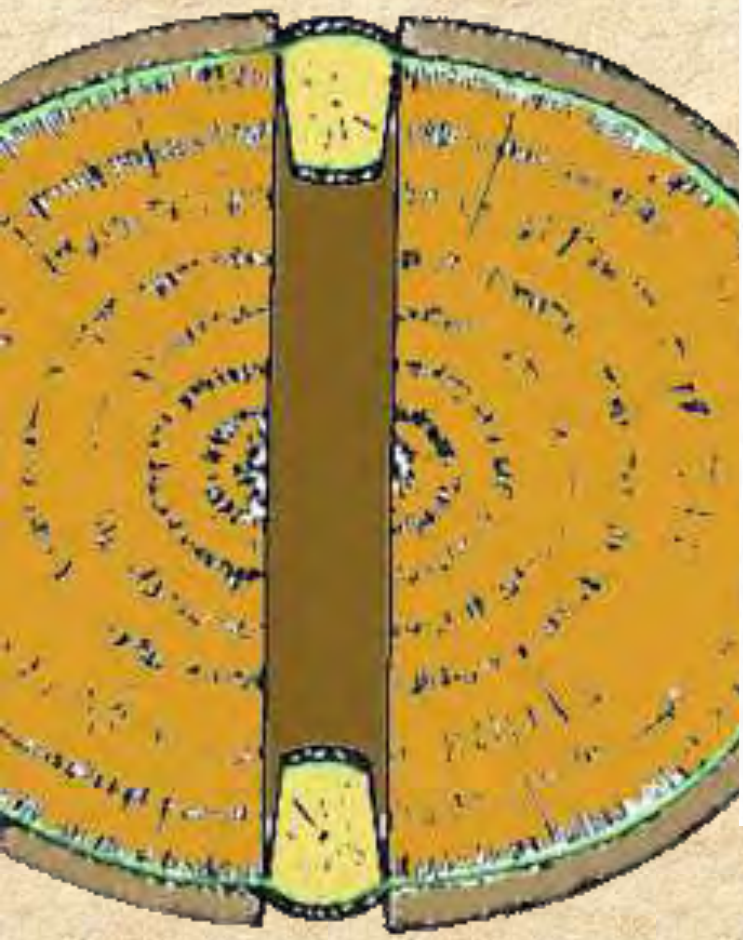
Cleft Graft



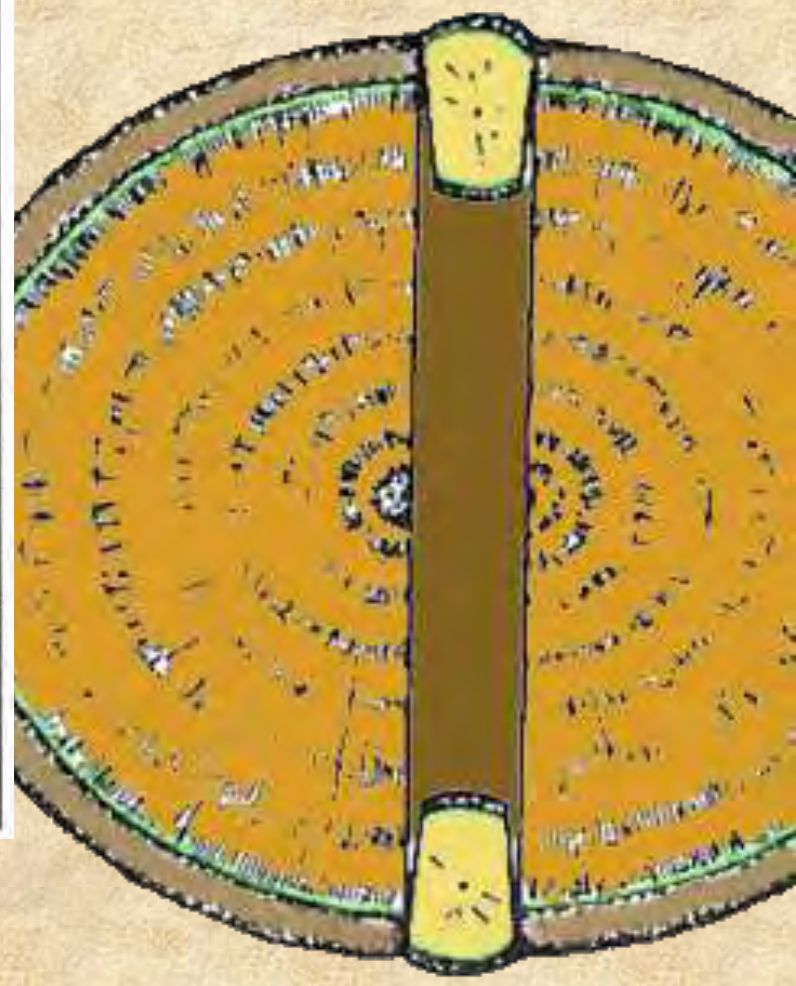
Cleft Graft

Be sure to align cambium

Right



Wrong



Topworking

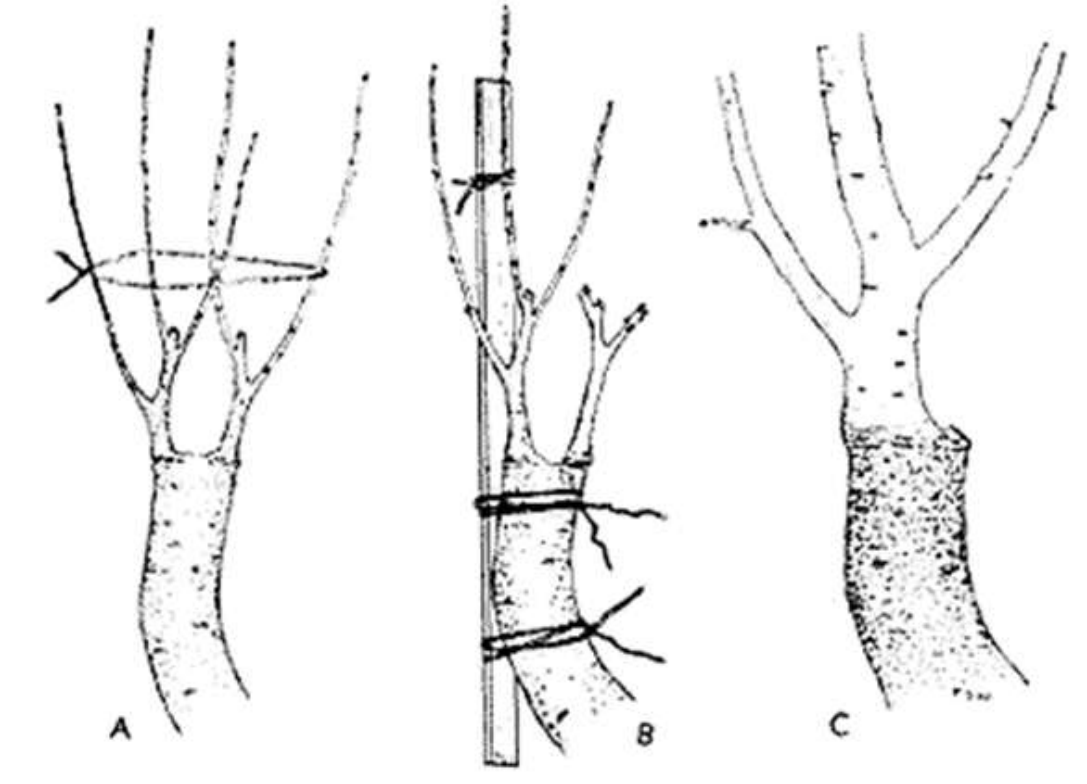
- When a desired variety is grafted onto the limbs of a mature tree it is called "topworking."
- The operation of cutting back the branches and top of an established tree and budding or grafting part of another tree on it.

Top Working

In this example of a cleft graft, three stages in the growth of a branch from a scion are shown.

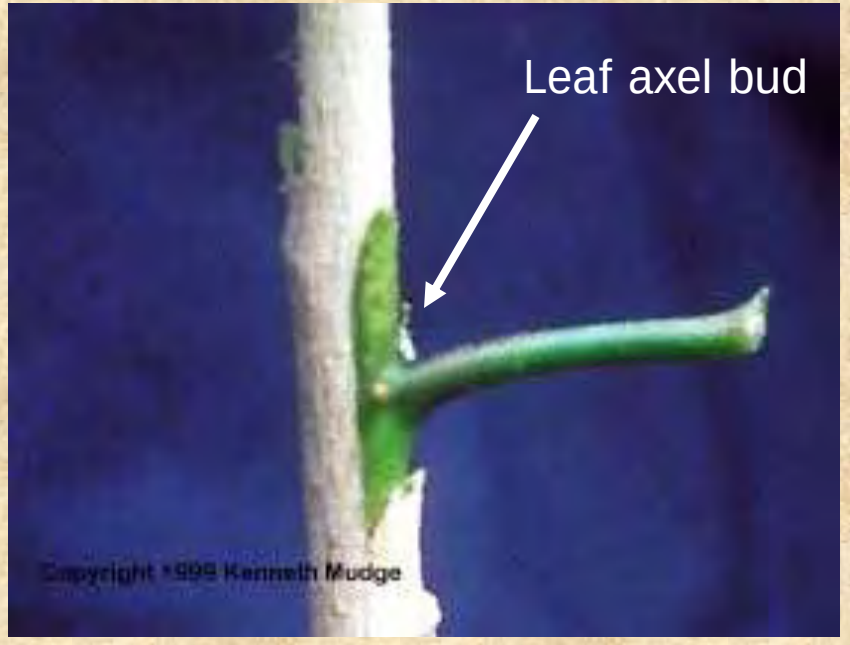
First season; let all scions and the shoot growth from below the graft grow undisturbed.

Second spring, select the most suitable scion as the permanent branch and consider the others as spares. Leave the spare scions on to assist in healing over the stub,



but cut them back to a few buds on each (see B). **The third spring**, severely cut back the spare scions again. In the fourth season, or when crowding is noted, cut off all of the spare scions as seems necessary (C).

Bud Graft



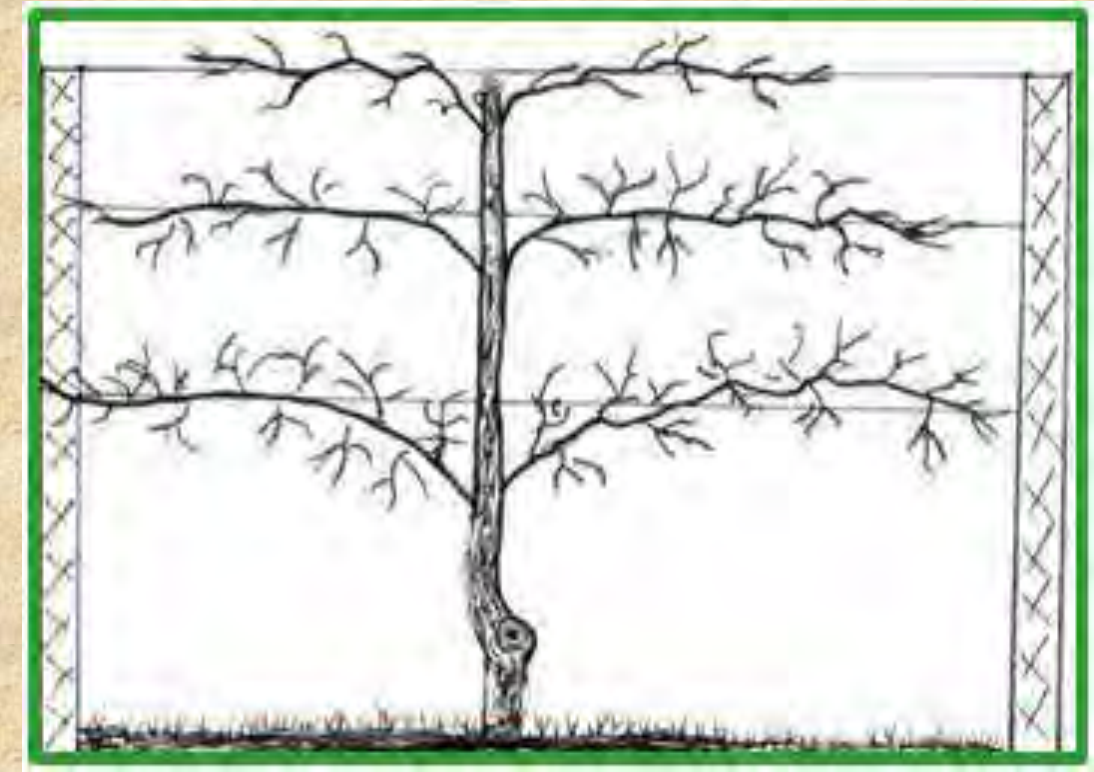
- Many of the apple trees and **all** of the stone fruit trees (plum relatives) sold in the area's nursery trade are propagated by budding.

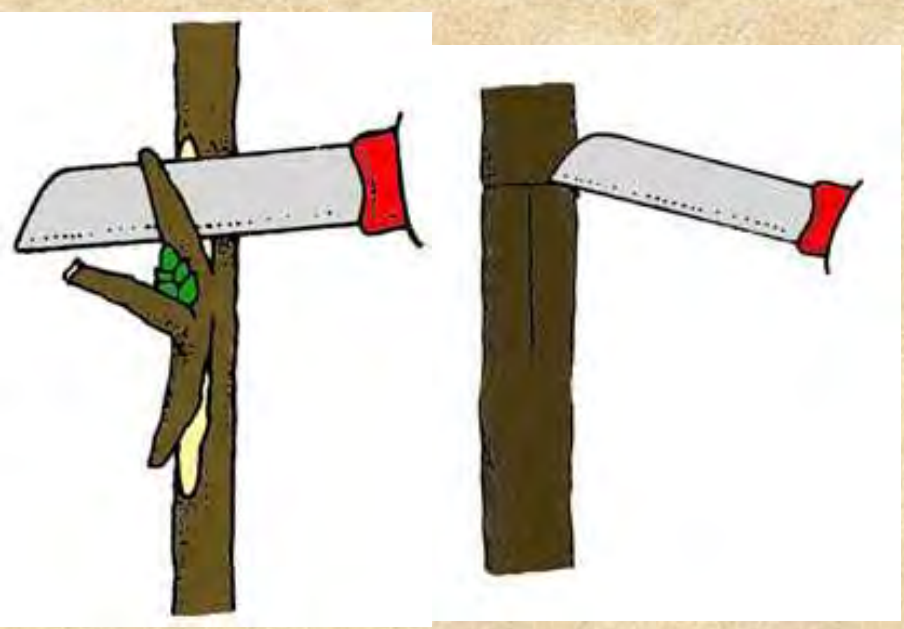
Multiple Graft Fruit Trees

M-7 rootstock with 3 tiers of branches with 5 of the following 6 varieties:

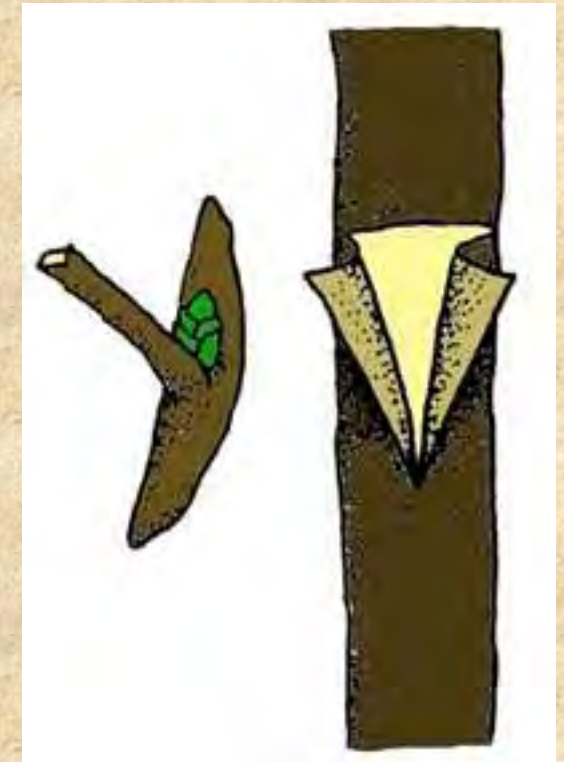
- Golden Delicious,
- Fuji,(Red Gravenstein)
- Gala,
- Red Delicious
- and Braeburn.

Select a spur-bearing variety

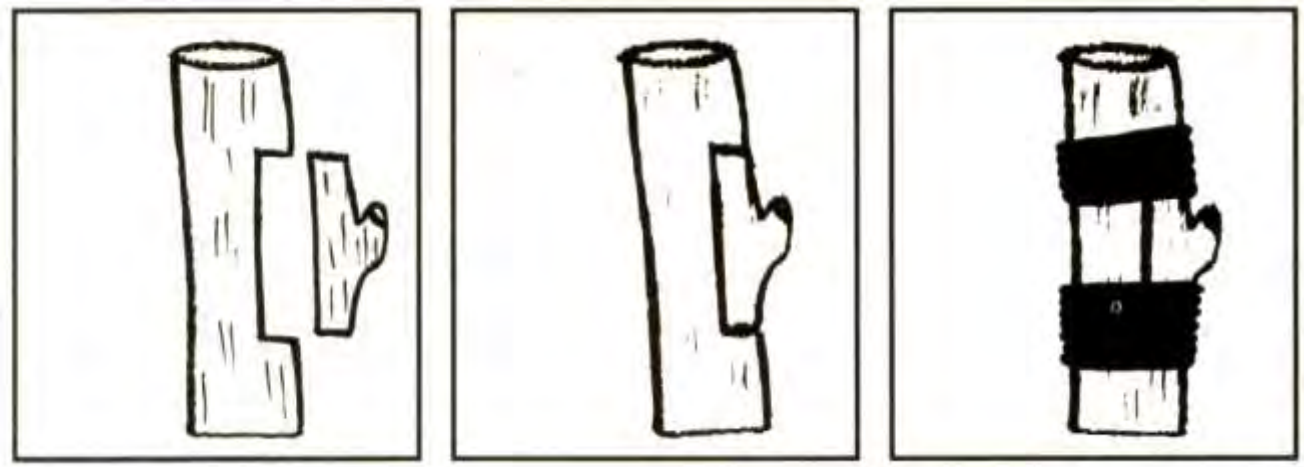


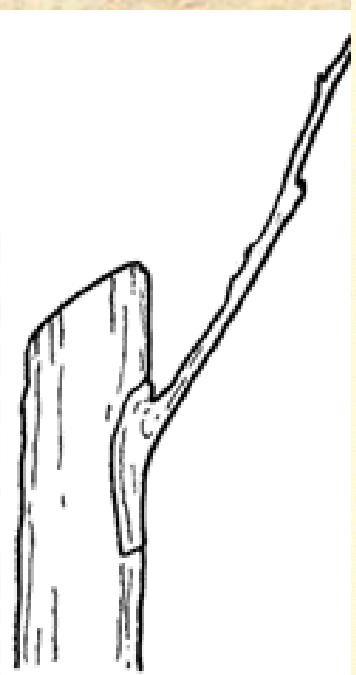


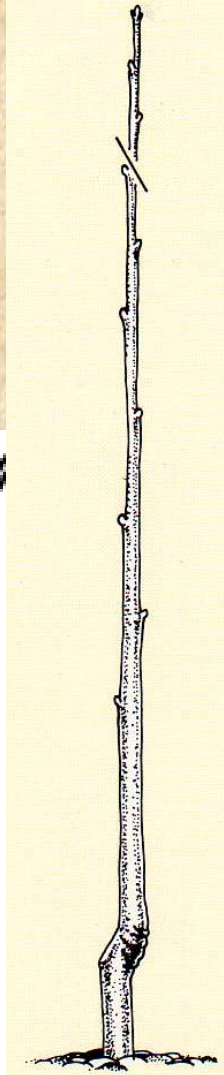
Propagation Using:
T or Shield Budding



Chip Budding







Chip budding is a technique that may be used whenever mature buds are available. Because the bark does not have to "slip," the chip-budding season is longer than the T-budding season.

Growing Multi-grafted Trees


Multi-graft apple tree


Open Center Leader

- Sometimes, more than one apple variety is grafted on the same tree.
  - This is reasonably satisfactory, but varieties have different growth rates and maturity dates,
  - so it's more difficult to prune and spray such trees.
- You can avoid these problems by planting several dwarf trees of different varieties.

COLUMNAR APPLE TREES

- Columnar apple trees are well suited to growing in a container.
- Columnar apple trees set their fruit along the main trunk.
- On columnar trees, cut any side branches short or off.
- Allow the leader to grow to the desired height. Some can eventually reach 10’ tall or more.

Mini-dwarf apple trees

Fourth Year's Spring

The scaffolding branches are in place, and it's time for this mini-dwarf to start bearing apples.

Red Chief

- Mini-dwarf apple trees are grown on very dwarfing EMLA 27 rootstock.
- They are easily maintained at only four to six feet tall.
- These highly productive, compact trees, grown in large pots on patios or….
- …are perfect to grow in a small backyard.

Growing Apple Trees in a Container

http://lifeonthebalcony.com/growing-an-apple-tree-in-a-container/

http://www.pacificgroves.com/patio.html

http://www.orangepippintrees.co.uk/articles/growing-fruit-trees-in-pots-and-containers

Container Growing Tips

Avoid pots with narrow base

If you start your benchgraft in a pot, **you can repot your apple tree any time of the year.** Start out with a one gallon container and move it to a two gallon by mid summer. Transplant to larger pots incrementally.

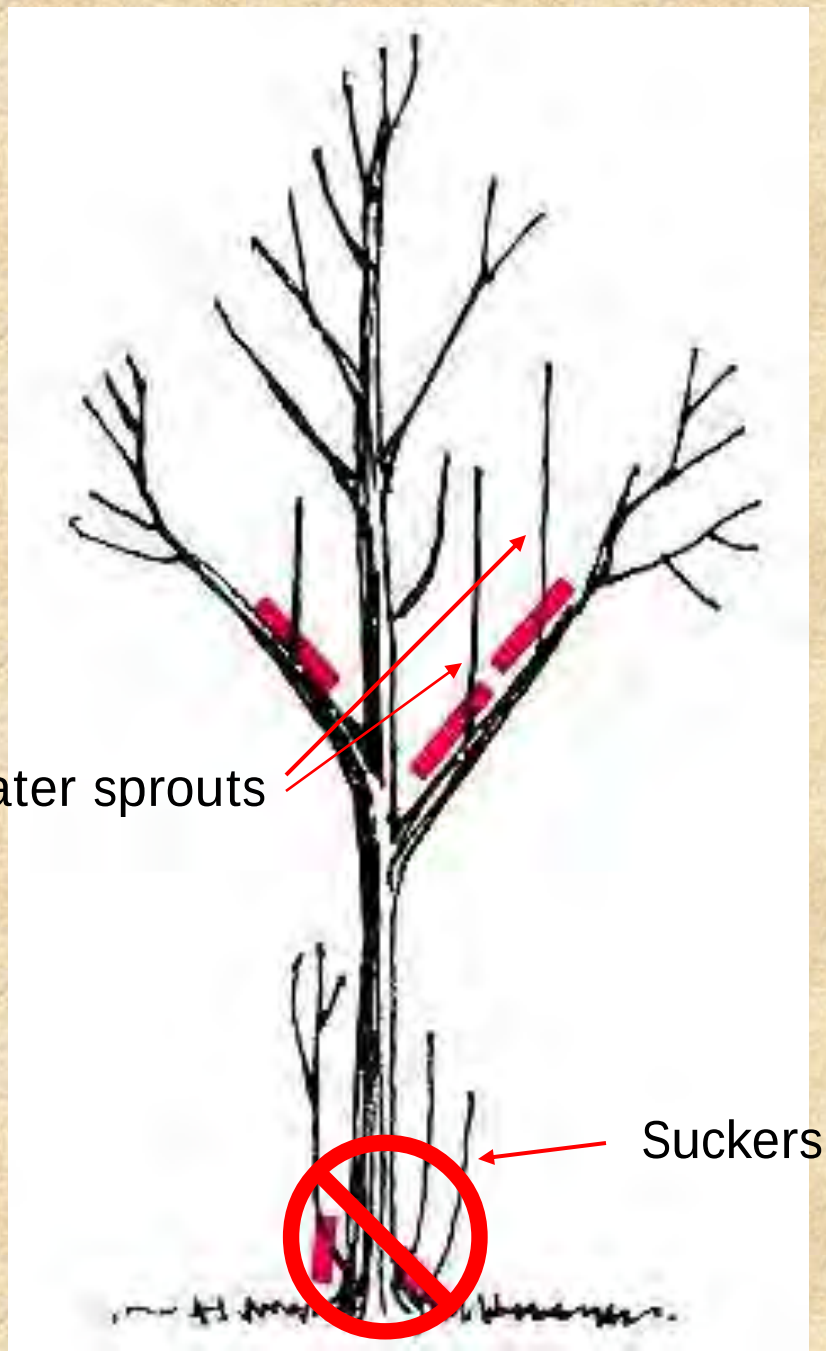
Use a good potting soil. Potting soils are designed to be used in a indoor or outdoor container. High quality potting soils are designed to create the complete ideal growing environment for your plants to grow and thrive in a container. All you have to provide is sunshine, by locating your plant in full sun, add fertilizer, and if needed, daily watering and occasional pruning.

Watering and Water Quality

- **When to water:** Check for moisture by putting your finger in the soil of the pot. Water the potted plant generously, if the soil is dry. If the soil is moist, hold off on watering.
- **Top watering** is the most common way to water potted plants. Pour water onto the soil surface and allow it to run through the pot until water flows out of the drainage hole.
- **Pour out the excess water** that flows out of the drainage hole. It may contains a small amount of soluble salts, a mineral that may injure your potted tree. Do not re-use this water or any water that contains harmful minerals.
- **Add a soluble fertilizer** to assist your tree's growth. Due to the limited amount of soil in a pot, the nutrients in the soil are quickly used up or washed away by frequent watering.

Scion Wood Selection & Storage

- Collect scions of one-year-old wood in the fall, winter or early spring.
- They may come from trees whose fruit you desire -- perhaps those of neighbors or friends. Scion wood is also available from nurseries or experiment stations.
- Scion wood should be placed in closed plastic bags with a moist paper towel and stored under refrigeration (32 to 40°F) until used.
- The grafting is done in early spring, usually before growth starts.



Scion wood collected from one year old wood or last year's growth

Scion Wood Source

Nick Botner
4015 Eagle Valley Rd.
Yoncalla, OR 97499
(541) 849-2781

Neighbor
Local Nursery
Home Orchardist

Maple Valley Orchards & Nursery
11541 Claywood Road
Gillett, WI 54124
Phone 920-842-2904
Fax 920-842-3204@

http://www.maplevalleyorchards.com/Pages/ScionWood.aspx

http://mountvernon.wsu.edu/FruitHorticulture/ScionwoodVarieties.html

Benchgraft Sources:

http://www.greenmantlenursery.com/fruit/apples.htm

Greenmantle Nursery
Heirloom Plants for the Garden

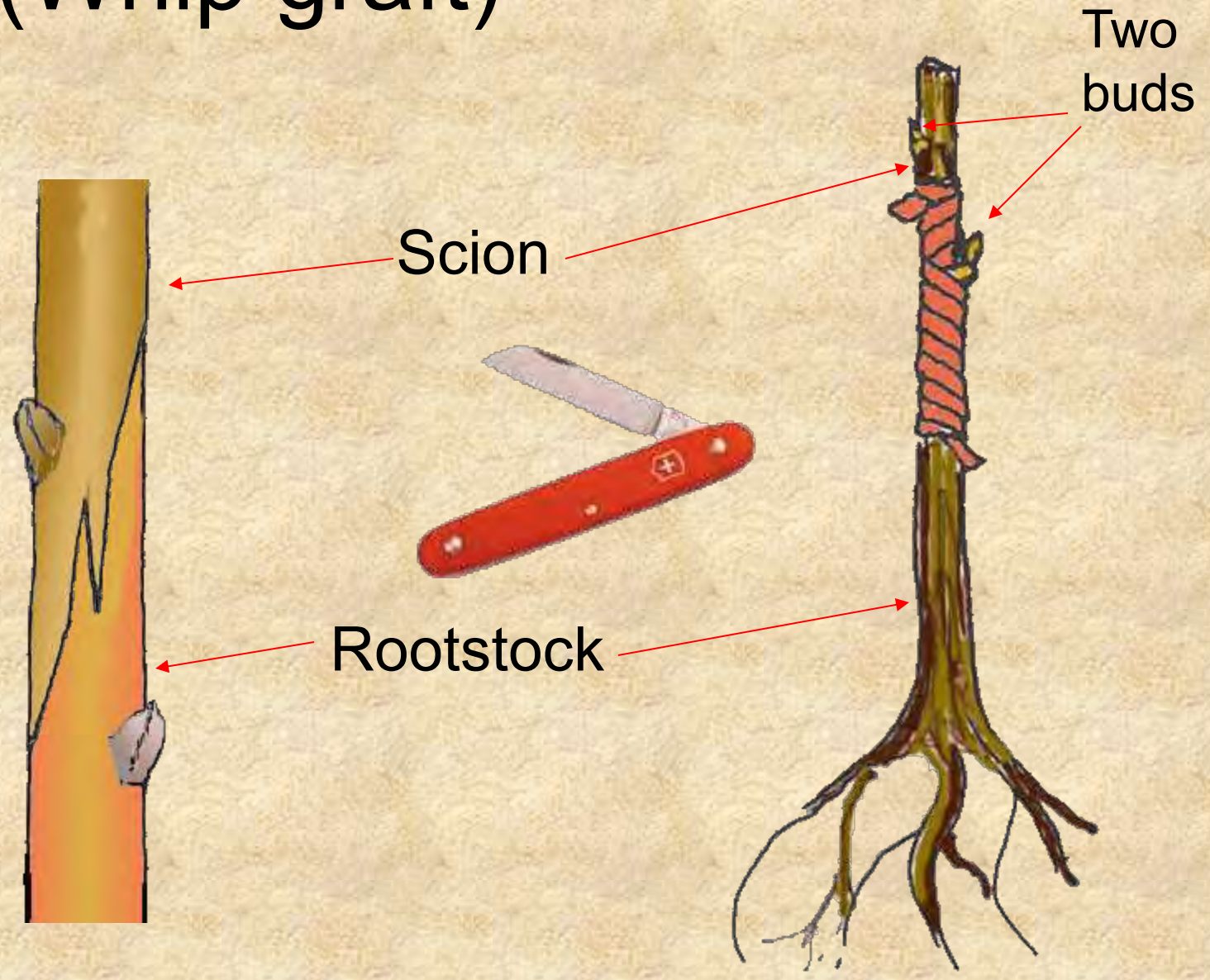
1 year growth of benchgraft

Greenmantle Nursery
3010 Ettersburg Road
Garberville CA 95542
(707) 986-7504

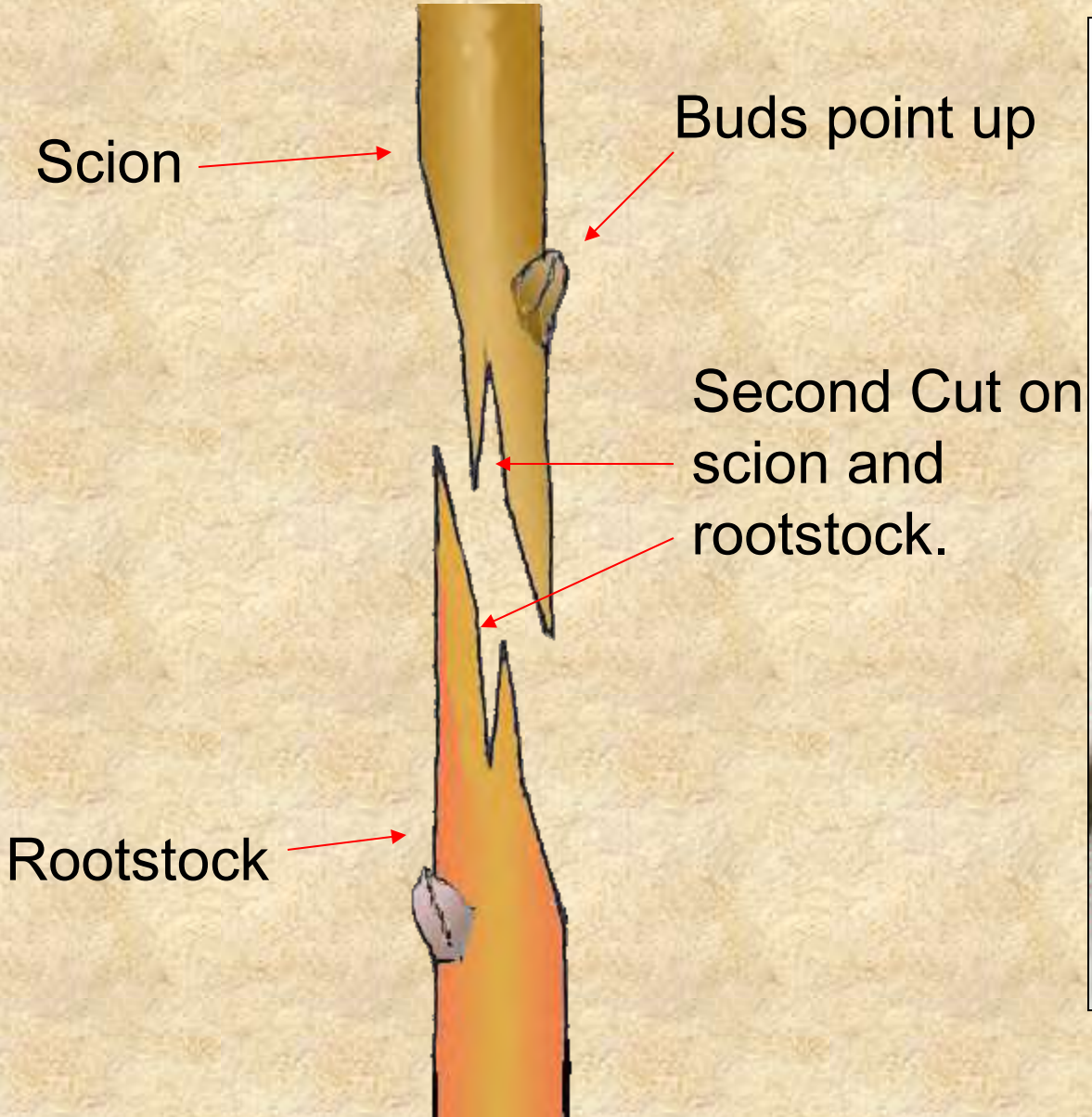
Apple Benchgrafts (whip-and-tongue) ready for planting

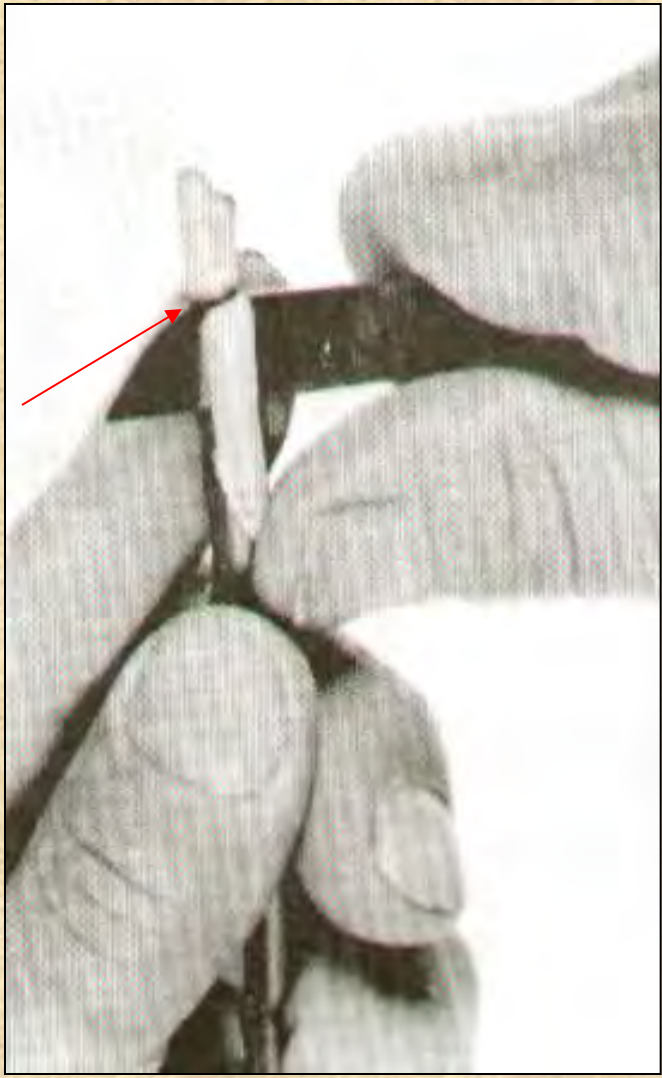
http://www.maplevalleyorchards.com/Pages/ScionWood.aspx

Whip-and-tongue graft (Whip graft)



Second Cut


Scion
Buds point up
Second Cut on scion and rootstock.
Rootstock



Putting it together

Using a Grafting Tool

Omega

Inverted Omega cut

Rootstock

Using a Grafting Tool

Scion

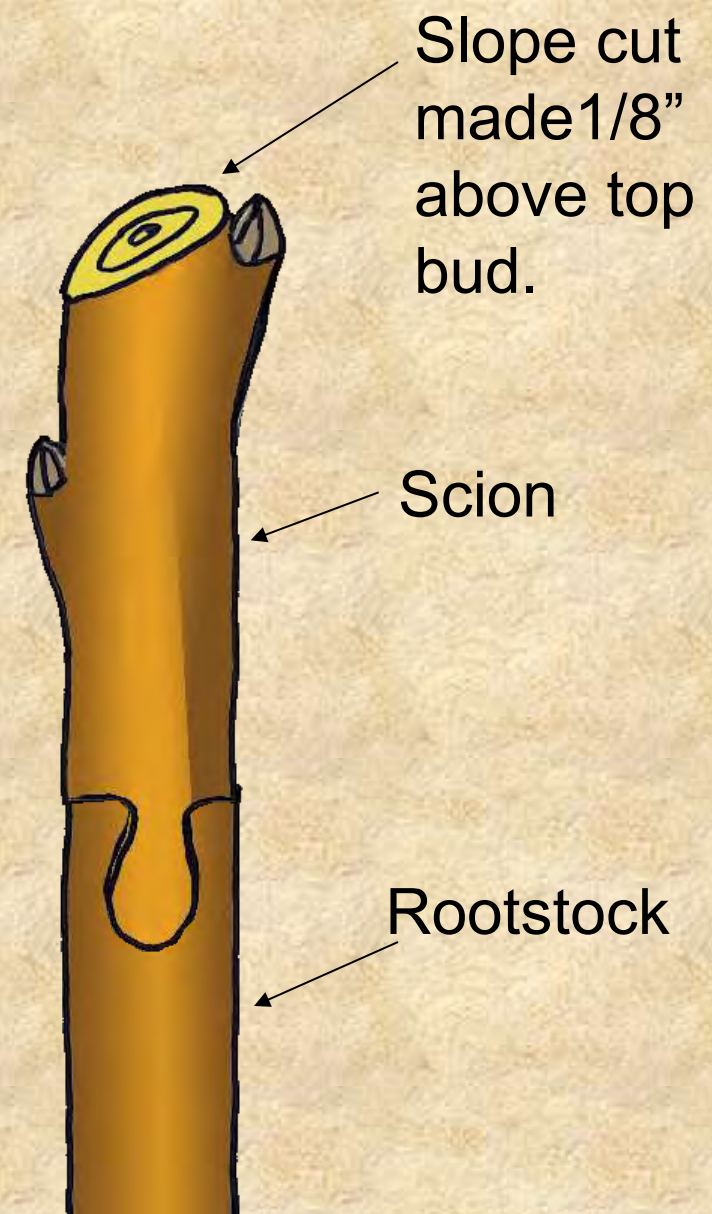
Grafting Tool

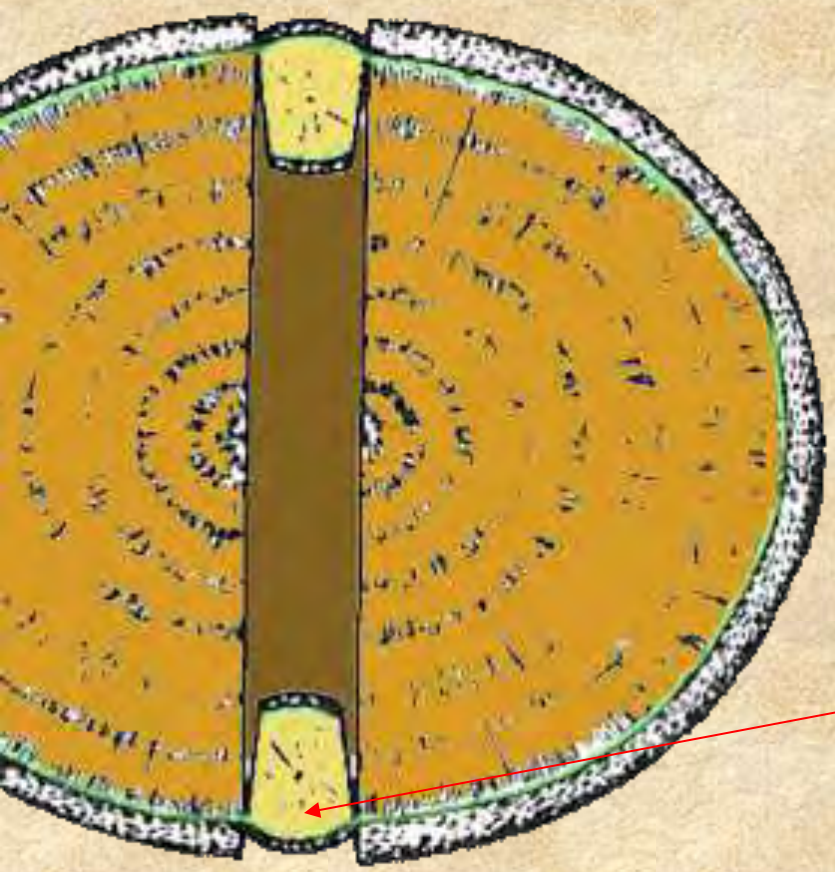
Slip the scion on to the rootstock from the side.

Rootstock

Cut both scion and rootstock with same tool.

Root stock should be (preferably) equal or greater in size than the scion.





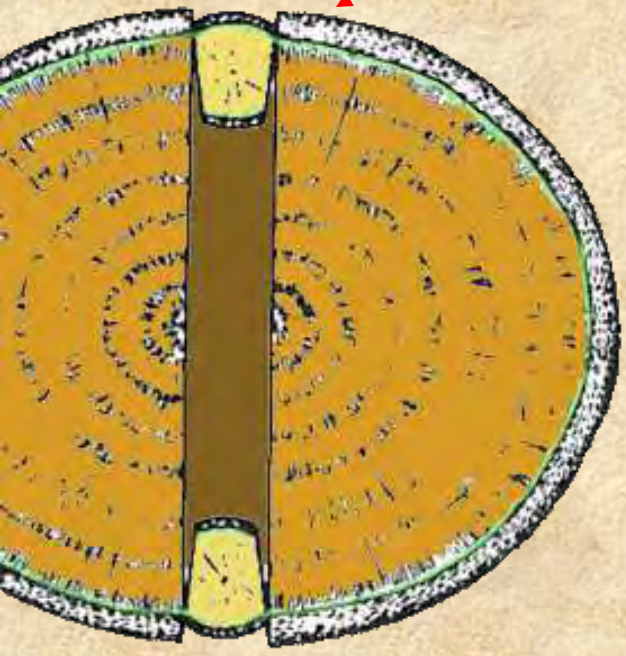
Scion

Rootstock

Therefore, the scion is often smaller but should never be larger

When the scion is smaller, align the cambial layers on one side

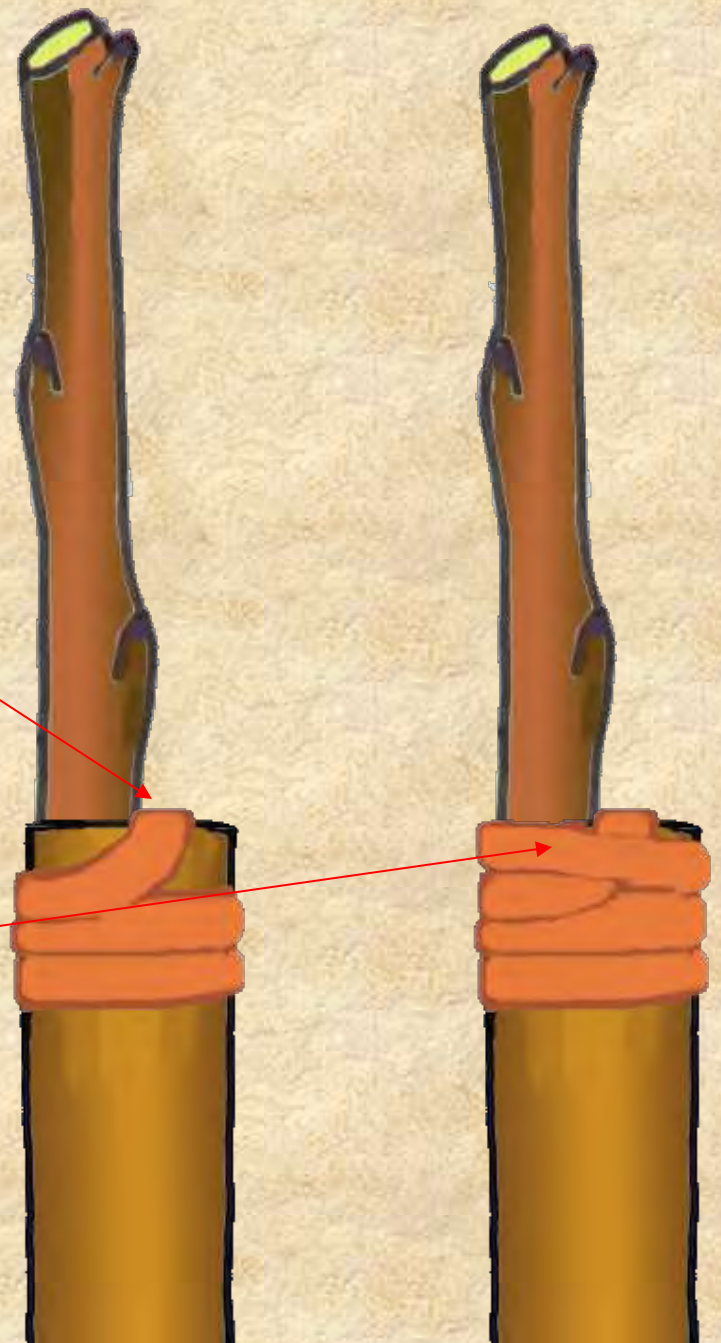
Cleft graft



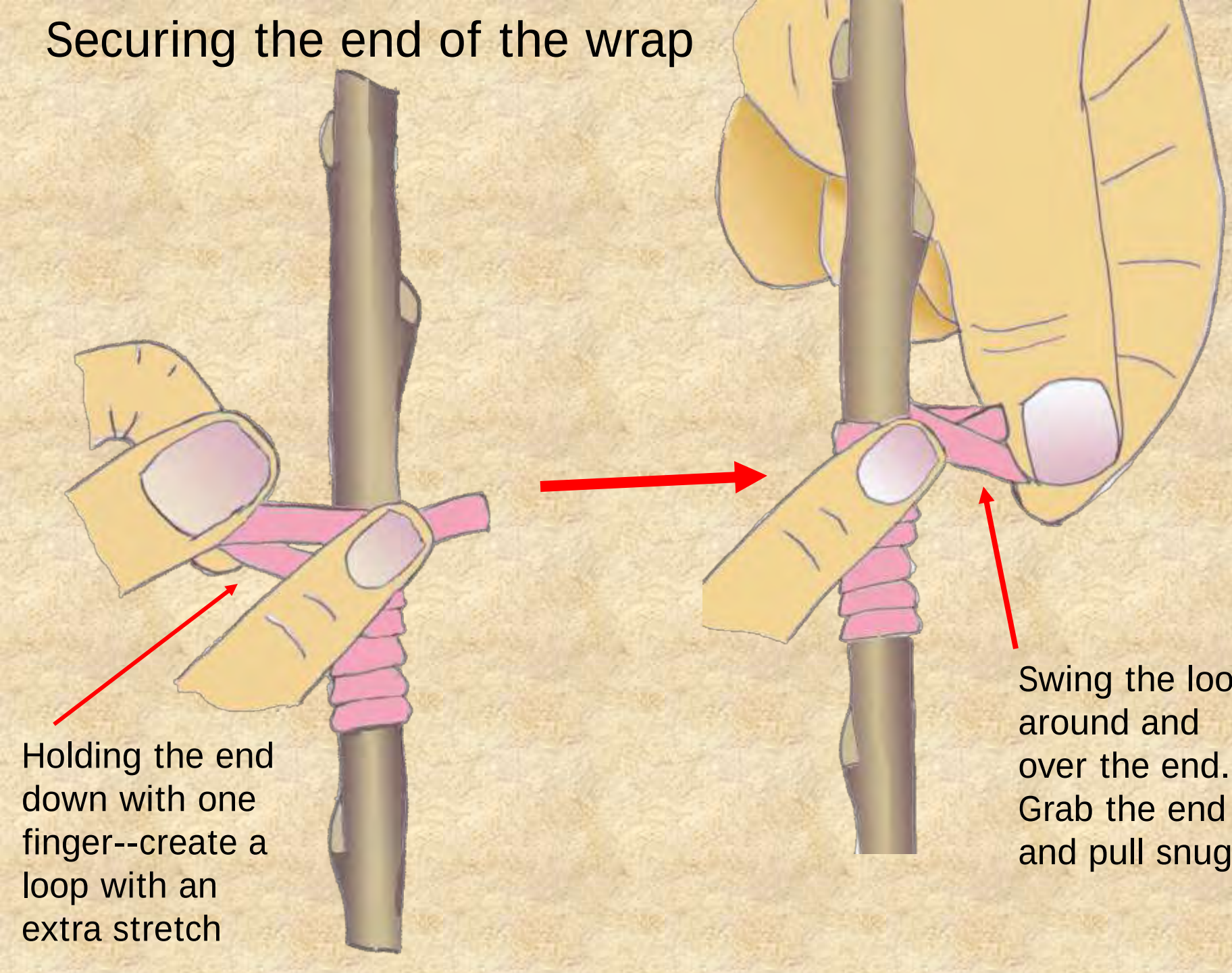
Omega grafting tool

Whip & Tongue graft

Anchor the aligned pieces by wrapping the elastic rubber over the ‘shoulder’ of the rootstock. Continue wrapping around rootstock until covered.



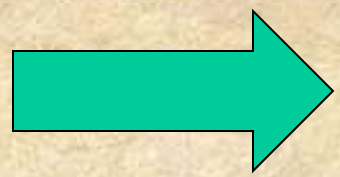
Securing the end of the wrap



Holding the end down with one finger--create a loop with an extra stretch

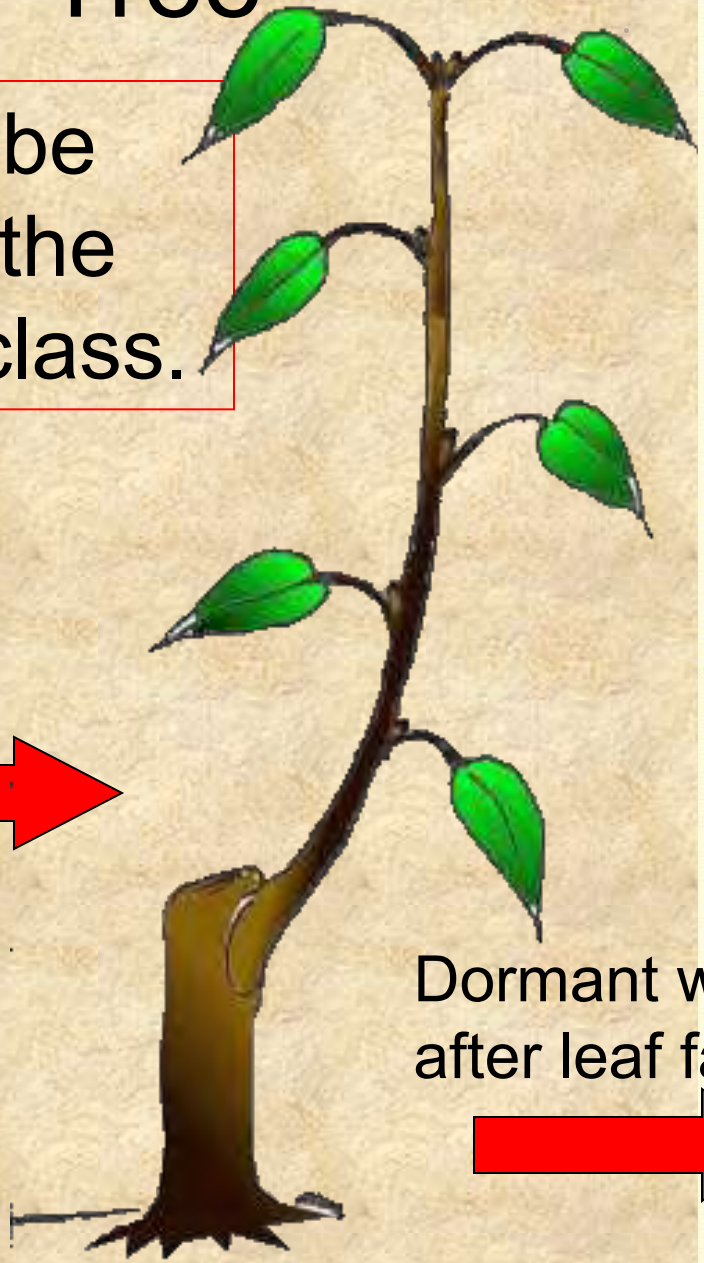
Swing the loop around and over the end. Grab the end and pull snug.

Apply tree seal to cover entire bud rubber area.

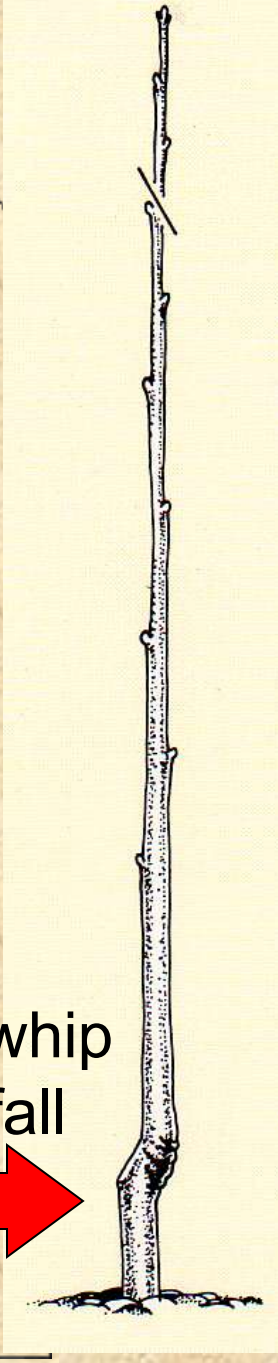


Care of Your New Tree

We will be here at the end of class.

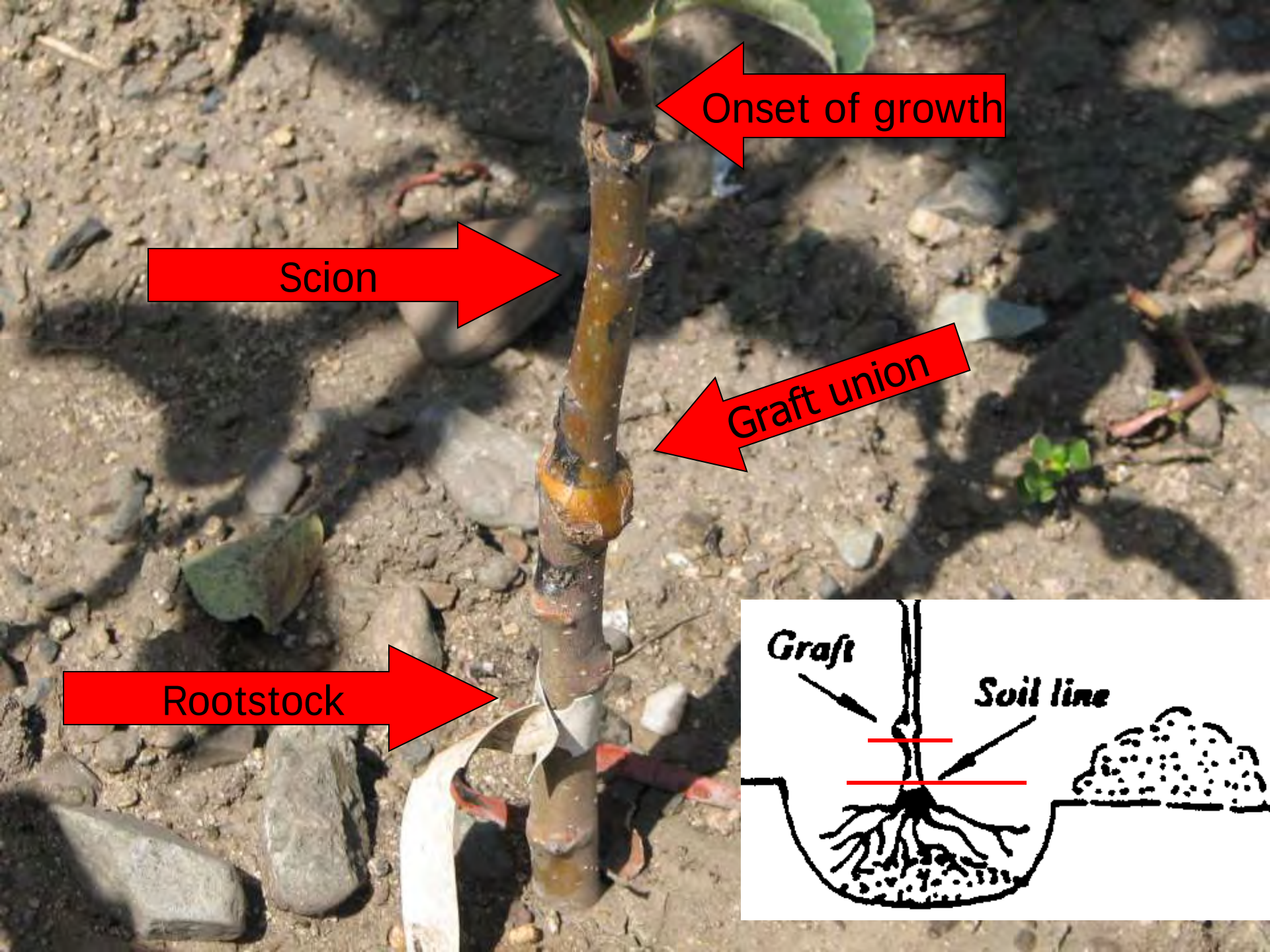


Dormant whip after leaf fall



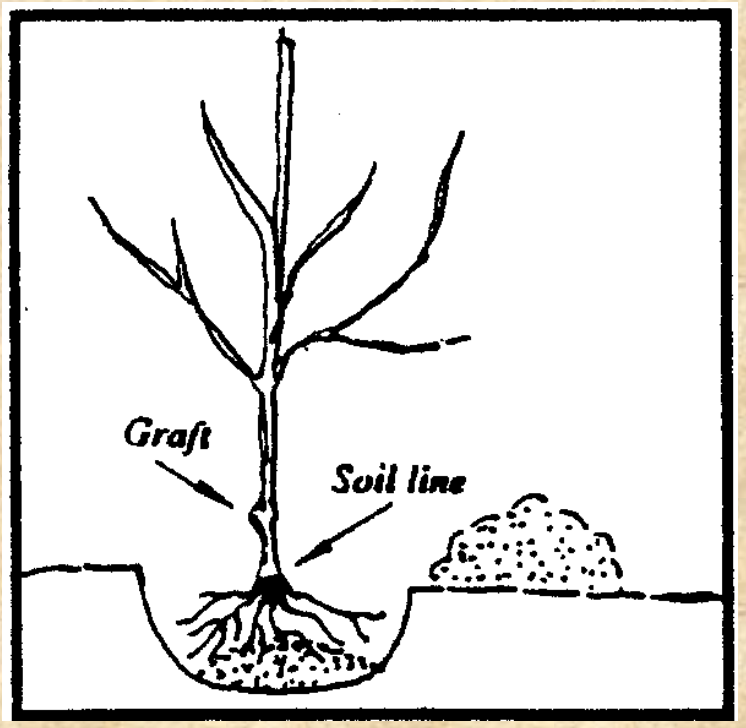
First summer's growth-select one shoot.

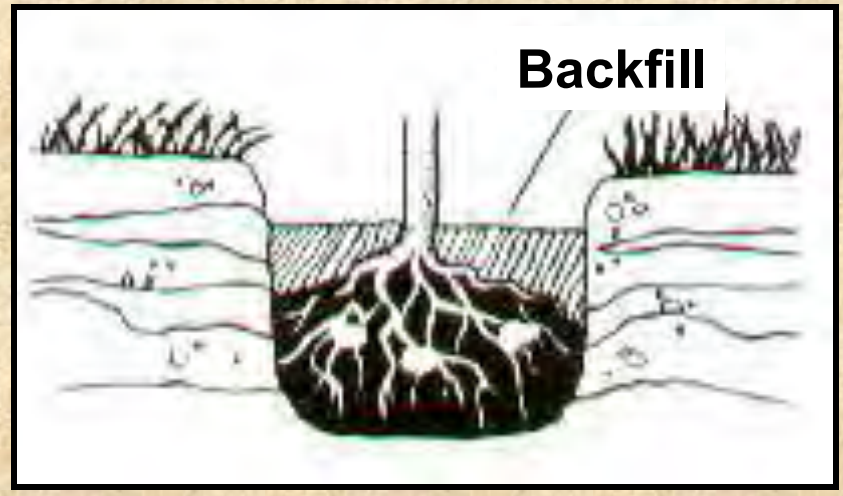

1 yr's growth
One year's growth
Rimnant of scion
Rootstock


Onset of growth
Scion
Graft union
Rootstock
Graft
Soil line

How to Plant

Make a mound in the bottom of the hole and spread the roots outward and slightly downward.



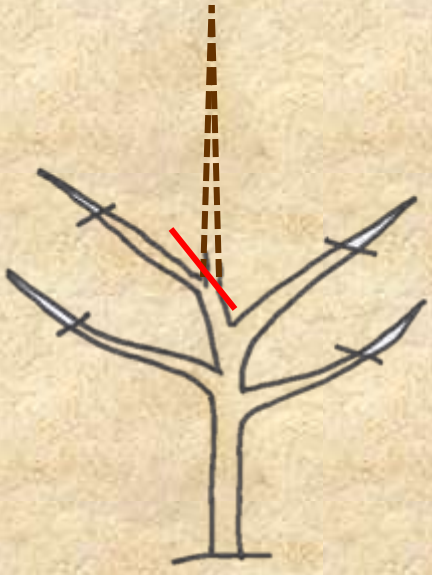


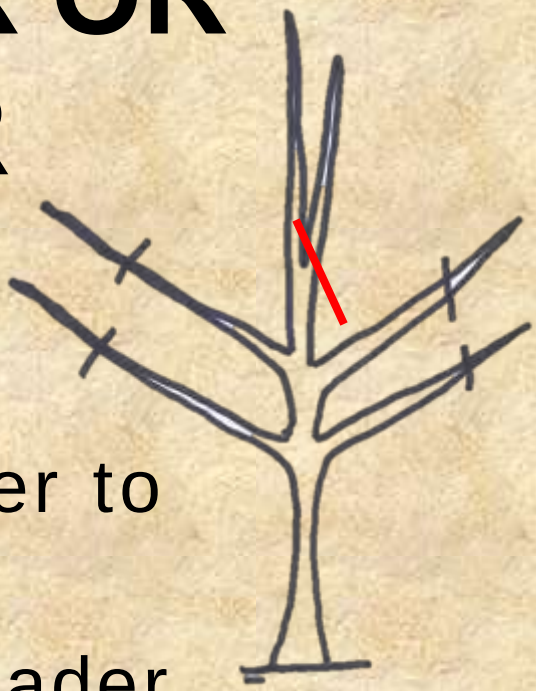
If you have heavy clay soil, dig a shallow hole and backfill with the native soil.

WHIP PRUNING

- “Whips” of dwarf’ apples should be headed back 1-2 feet from the ground to encourage branching low to the ground.
- Whips of most other trees should be headed back to 3-4 ft.
- The top bud usually sprouts and grows strongly upright to form a new leader, while lower buds will usually grow more horizontally and make side branches.

CENTRAL LEADER OR OPEN CENTER





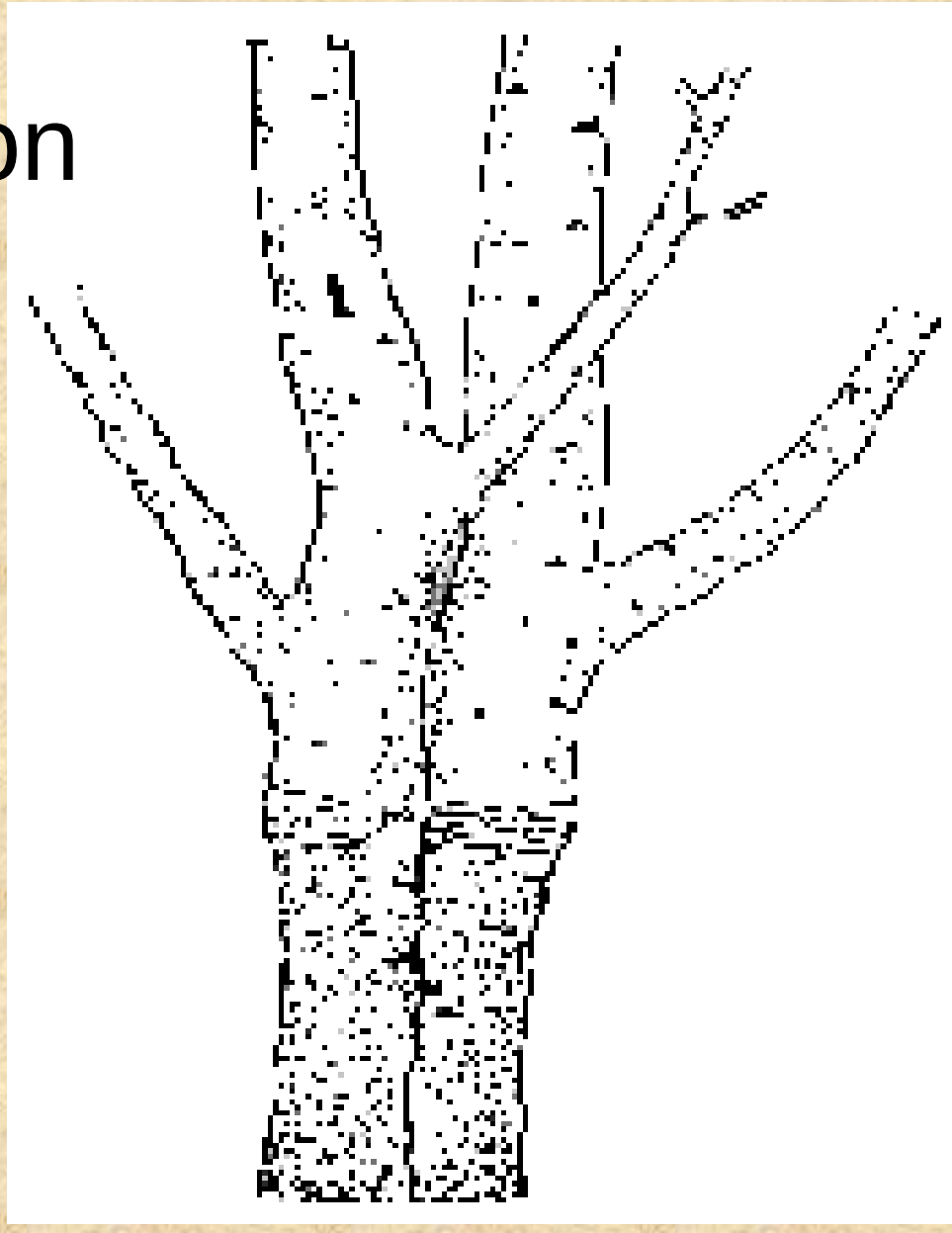
Start by deciding whether to prune to an

open center or central leader.

- Open center which was used with multi-grafted trees requires more space.
- Central leader training and pruning is used now days on dwarf and semi-dwarf trees.

Avoid Bark Inclusion

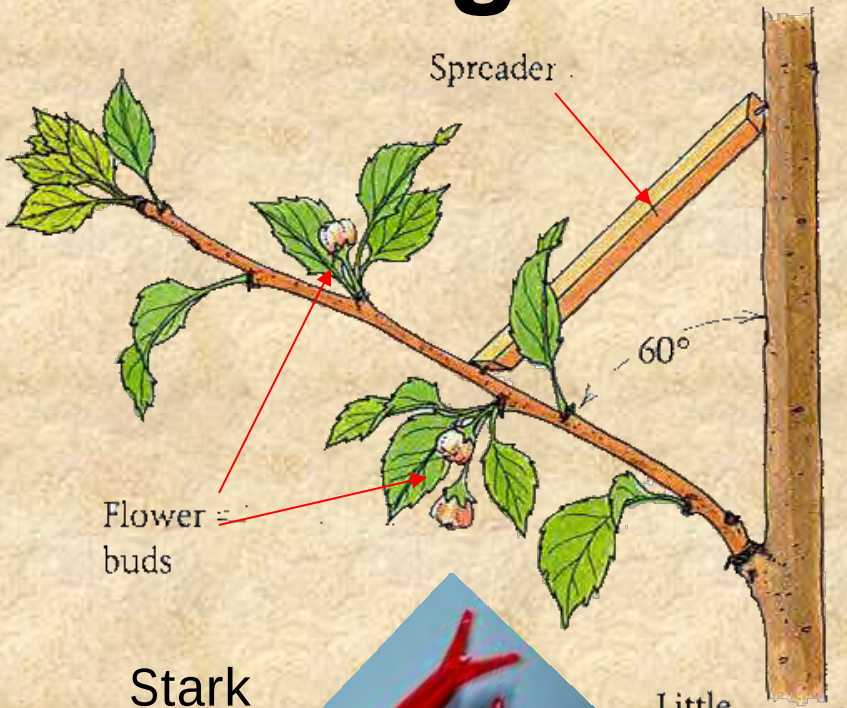
Trouble ahead in the next storm. Don't let two leaders compete.

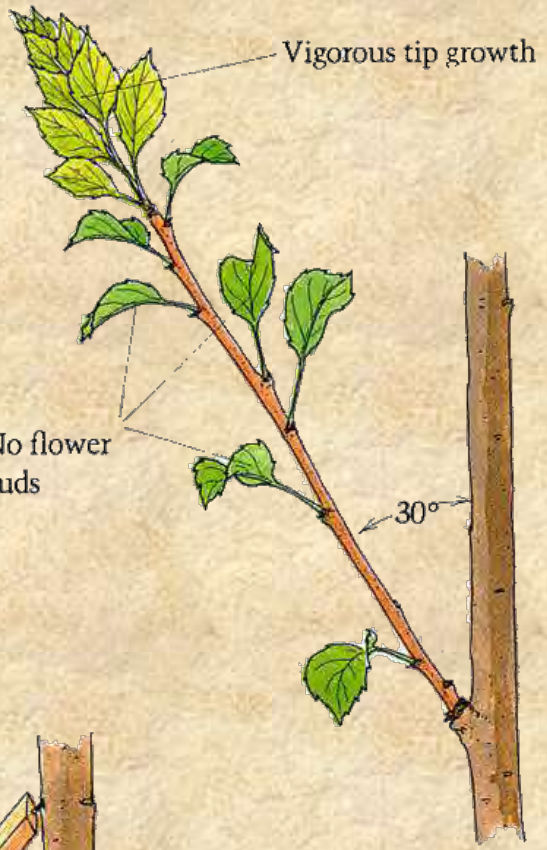


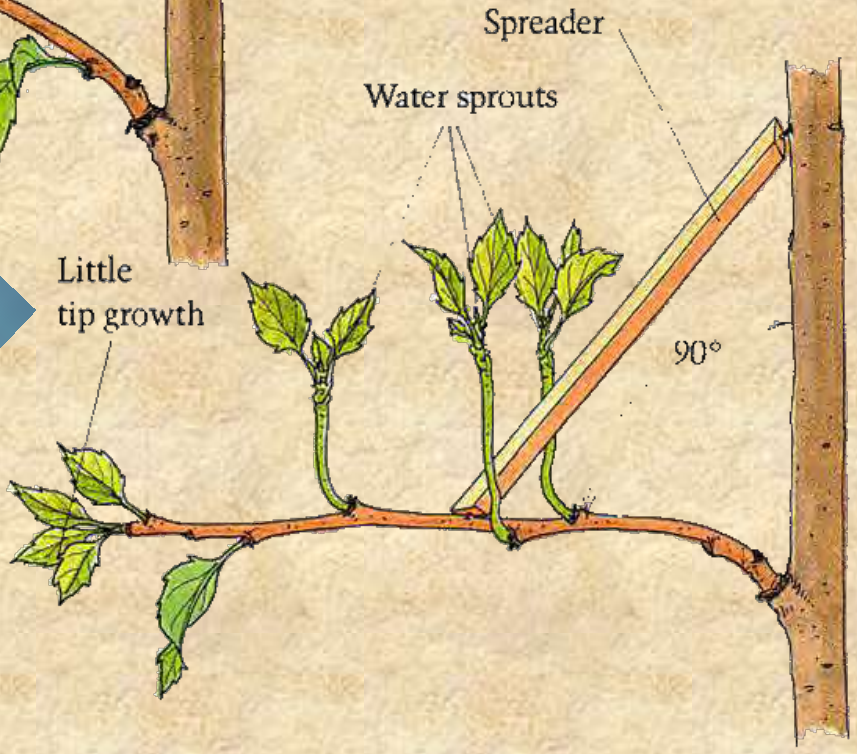
Training and Pruning

Choose 4 to 5 branches evenly distributed around the tree, hopefully about 90 degrees apart. When there are five, look for a starfish configuration.

Importance of angle of growth







Using spreaders

Training and Pruning

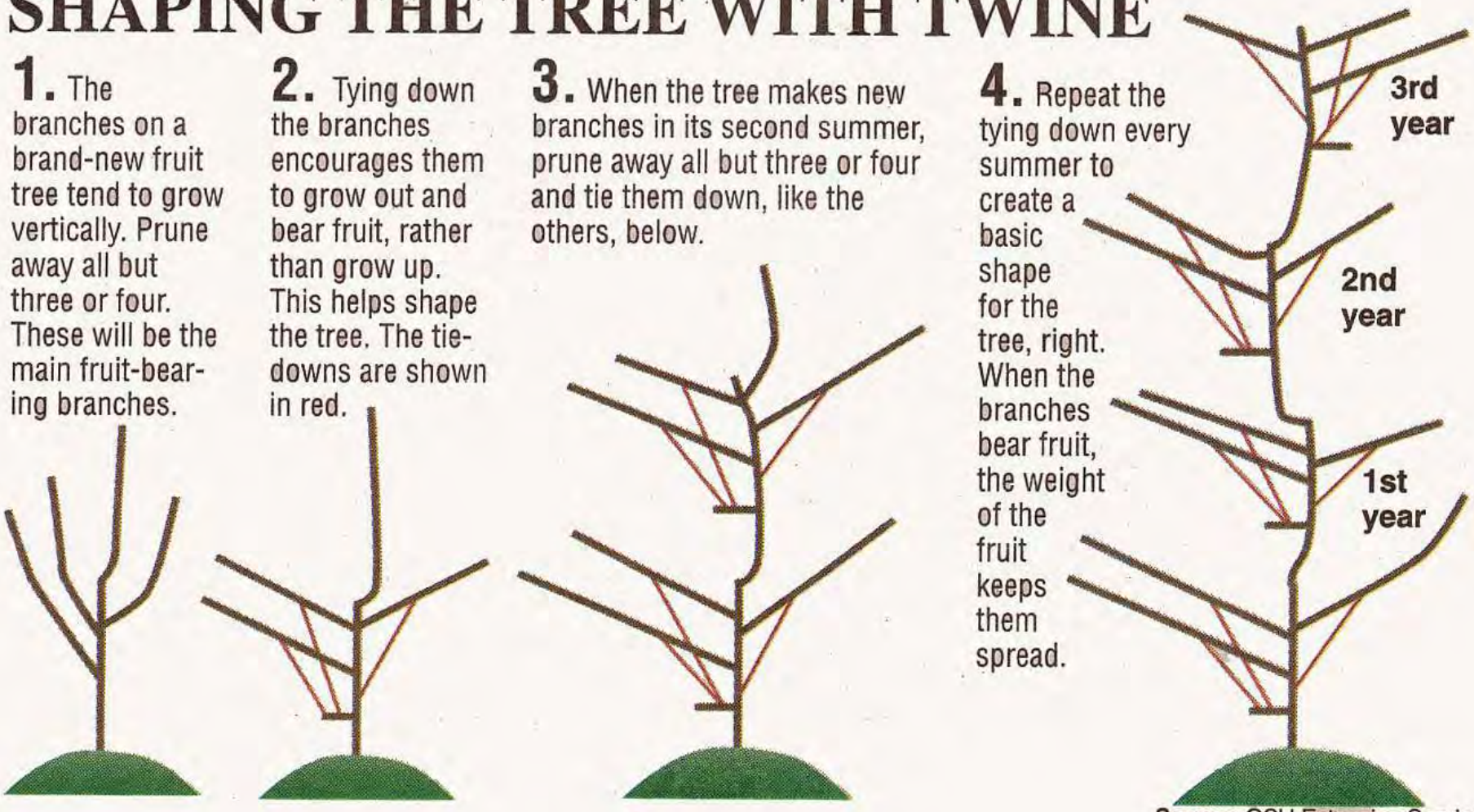
SHAPING THE TREE WITH TWINE

1. The branches on a brand-new fruit tree tend to grow vertically. Prune away all but three or four. These will be the main fruit-bearing branches.

2. Tying down the branches encourages them to grow out and bear fruit, rather than grow up. This helps shape the tree. The tie-downs are shown in red.

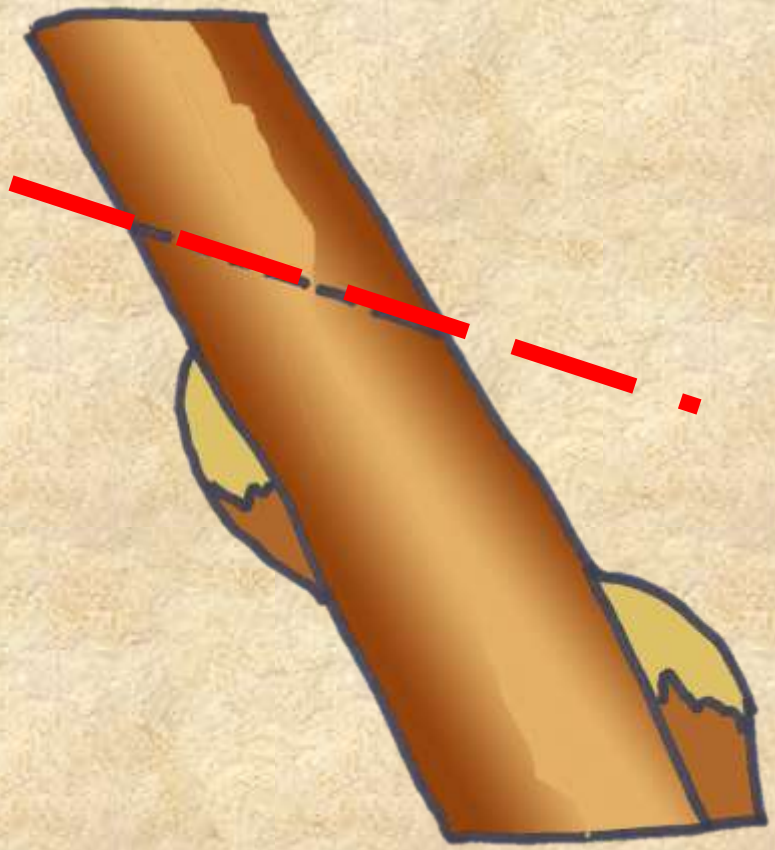
3. When the tree makes new branches in its second summer, prune away all but three or four and tie them down, like the others, below.

4. Repeat the tying down every summer to create a basic shape for the tree, right. When the branches bear fruit, the weight of the fruit keeps them spread.



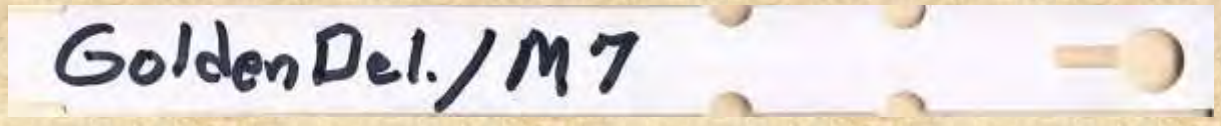
Source: OSU Extension Service

PRUNE TO AN OUTSIDE BUD

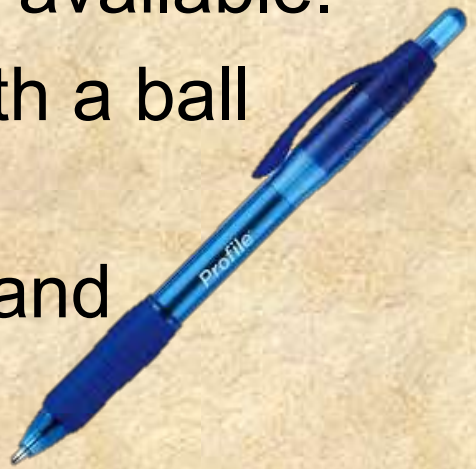


- On all plants, try to make sure the last bud you leave on a side branch is headed away from the center of the plant.
- This last bud determines the direction the branch will grow.

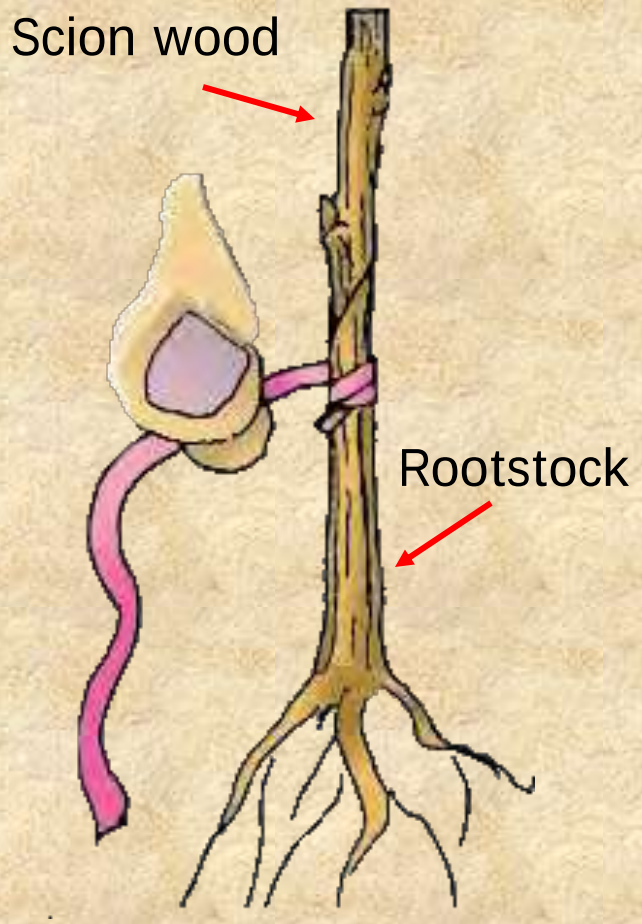
USE PERMANENT LABELS

- A plastic label will fade and become unreadable within a year. 

- More permanent aluminum markers are available.
- Simply write on each aluminum label with a ball point pen.
- Its best to write the name of the variety and rootstock.
- Put it around a small branch. Every few years loosen the wire around the branch.



Review: Four Criterion for Successful Graft Union Formation



1. Cambial contact
2. Avoidance of desiccation
3. Compatibility
4. Pressure

List of Apple and Pear Scion Wood

- Apple:
  - Braeburn
  - Golden Del.
  - Gala
  - Melrose
  - Granny Smith
  - Fuji
- Pear:
  - Paragon

Summer Apples

Red Gravenstein

Zestar

Pristine

Gala

Mid season

~~Greensleeves~~

Golden Delicious

Crimsoncrisp

Fall Apples

Melrose

Fuji

Braeburn

Granny Smith

Early Bloom

Red Gravenstein

Zestar

Pristine

Early Mid

Braeburn

~~Greensleeves~~

Mid to Late Bloom

Golden Delicious

Gala

Fuji

Granny Smith

CrimsonCrisp

Melrose